HILAND LASSIE BOGIE

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THE MODEL ENGINEER

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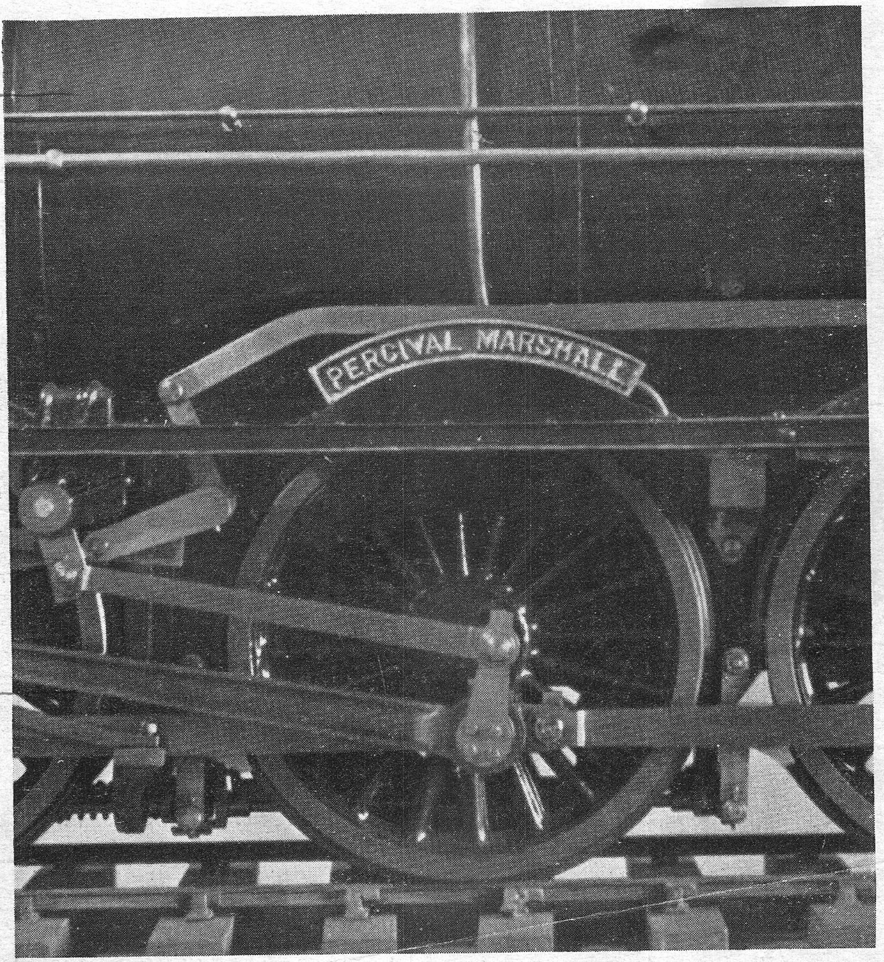
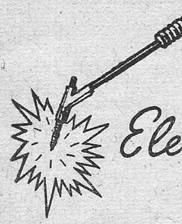
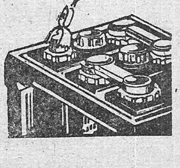


Mr. G. R. Hill, of Montrose, has given his ¾-in. scale L.M.S.R. 4-6-2 locomotive a name well known to our readers, as seen above. The engine is described and illustrated in this issue





THE MODEL ENGINEER

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Smoke Rings

Looking Backwards

A NOTE from Mr. H. J. F. Maton opens with these words :—" I find on looking through my old copies of THE MODEL ENGINEER that the oldest is dated February, 1901. So I have been a reader for 45 years, and, therefore, thought I would like to write you a short note." That is a very good reason for writing me, and Mr. Maton's reminiscences of his 45 years of readership have given me much pleasure. He comments on the changes which have taken place during this long period, and I can well imagine his thoughts as he compares THE MODEL ENGINEER in its youth with the present volumes. Designs, methods, and equipment have all changed very much, but there is one thing which has remained unaltered, and that is the spirit of enthusiasm of the readers. Mr. Maton says he was a schoolboy when he started to read THE MODEL ENGINEER, but the constructive urge still waxes strong, and though his favourite $2\frac{1}{2}$-in. gauge locomotive was destroyed in the 1941 air raids, he is going to build another as soon as materials are more plentiful. He concludes with the wish " Long may THE MODEL ENGINEER flourish," a desire which I warmly reciprocate.

Castings

THERE is an air of magic attaching to the word " Castings " in the minds of many model engineers, particularly with those in the early stages of the hobby. To the advanced worker a casting is merely a material of construction, simplifying, and, perhaps, expediting certain details of his work. There is no romance attached to it, and it passes into its prescribed place in the engine or machine being built, after the necessary boring or shaping or drilling called for by the design has been carried out. To the beginner, however, a casting, or a set of castings, has a special significance and attraction. It enables him to see his engine more definitely in shape than he can do from a drawing, and he feels he is almost half-way along the road to completion. Moreover, there is a feel of real engineering to be working on a casting. But there are castings and castings. Some are beautifully cast in good sound metal, with a clean surface, and complying accurately with the design they represent. Others, perhaps intended to suit the same design, are crude and lumpy, with a hard skin on the surface, and possibly blow-holes in the interior. They may also depart in some essentials from the designers' intentions in the way of curves, and bosses and flats, and in cored holes, because sufficient care has not been given to the preparation of a good pattern. In general terms these are all " castings," and may be sold as such without dishonest mis-description and yet they bring disappointment to the purchaser. I make this point because the model engineering hobby is on the eve of a wide development, and the demand for castings for new and improved designs, as well as for old favourites, is bound to increase. I would urge all those catering for a trade in castings to spare no trouble or expense in the preparation of really good patterns in the first place, and subsequently in the supply of high grade metal and clean castings. There are already some firms in the trade who are noted for the high quality of their castings and who have accordingly acquired an enviable reputation. Such a good name spreads rapidly wherever model engineers are gathered together, and I cannot emphasise too strongly the value to business success of the right kind of reputation for accuracy and quality in this important branch of the trade.

An Old Lathe

A NEW reader, an apprentice at the G.W.R. Swindon works, writes as follows :—" After reading the paragraph on ' Old Lathes Never Die,' in a recent issue of THE MODEL ENGINEER, I felt I must tell you of a real old-timer, whose wheels are still turning, a whole century after leaving the makers' works. I have noticed a lathe, bearing a plate inscribed ' J. Whitworth & Co., Manchester,' the maker's number is 38, and the date given is 1846. It has a flat top-bed 12 ft. long, and centres of $8\frac{1}{2}$ in., and consists of two fixed headstocks, one table, two tailstocks, and an attachment for lapping ; it is actually two lathes in one, there is no back-gear or leadscrew ! Headstocks each have four pulleys, with steps of 4, in., $5\frac{13}{16}$ in., $8\frac{1}{8}$ in., and $10\frac{1}{16}$ in. Its uses are, one half of the lathe for parting off pins for locomotive valve-gears, and the remaining half is entirely used for lapping out the holes in guides, eccentric-rods, quadrants, etc. The lathe is installed in the ' R ' Shop, Locomotive Department, G.W.R. Works, Swindon, and runs from the overhead shafting. I might add, that I am a premium apprentice engine fitter, turner and erector, and am working in the ' R ' Shop."

Percival Marshall

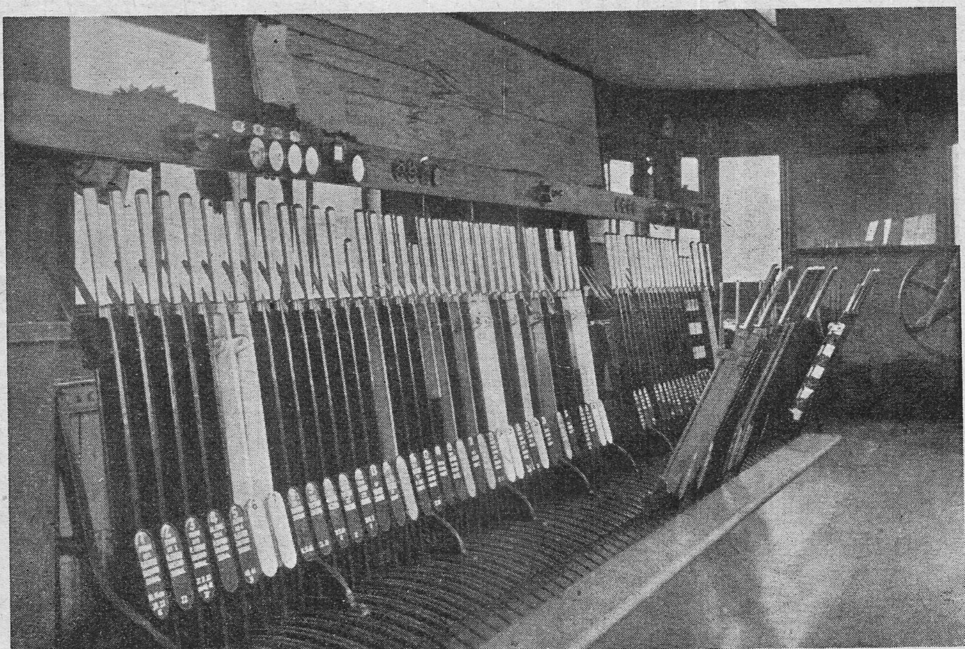
Railway Interlocking Frames

By O. S. NOCK, B.Sc., A.M.I.Mech.E., M.I.R.S.E.

INTRODUCTION

INTERLOCKING, as applied to the working of signals and points, is one of the most fascinating branches of railway engineering. The designing of the mechanical interlocking mechanism for even a moderate-sized station, or junction, usually resolves itself into a complicated jig-saw puzzle, in which it is rare that any two layouts can be solved by working on similar lines. This point will be readily appreciated by any careful student of railway operation ; but what is, perhaps, not generally realised is the extent to which design of the actual frame, as distinct from the locking mechanism, varies on different railways. Most frames look more or less alike when seen from the operating-room of a signal-box ; there are variations to be quickly noted in the shape of the levers and catch-handles, but the fundamental differences are not revealed, and it is these that are to be described in this series of articles. Generally speaking, there are two broad classes of mechanical interlocking frame : the first embodies "lever locking," in which the locking is actuated by the stroke of the lever itself ; in the second, which uses "catch-handle locking," the lever catch cannot be lifted if the lever is not free to be pulled, since it is the movement of the catch and rod, and not that of the lever that works the interlocking mechanism.

To a model-maker, working to a scale of, say, 1½ in. to the foot, locking frames offer scope for some beautiful work, and even though not more than a few were chosen for building from the range about to be described, the eventual owner would possess historical records of no mean importance. The early history of interlocking is a subject in itself, though obviously one that can only be noticed in passing here ; with two exceptions the frames described all embody the great principle of tappet locking invented by James Deakin, of the firm of Stevens and Sons, in 1870. At that time, a great number of inventors were busy ; many were the rival schemes, and lawsuits over alleged infringement of patent were frequent. Of the numerous alternatives and predecessors of tappet locking, I have chosen two for inclusion in this series, and of these the McKenzie and Holland "cam and rocker" system enjoyed an extraordinarily long innings. Indeed, hundreds of such frames are still in service today. Among the four main-line railways in Gt. Britain, there is no uniformity in locking frame design, and the whole subject forms an intensely interesting



A modern signal-box interior, Bognor Regis, Southern Railway

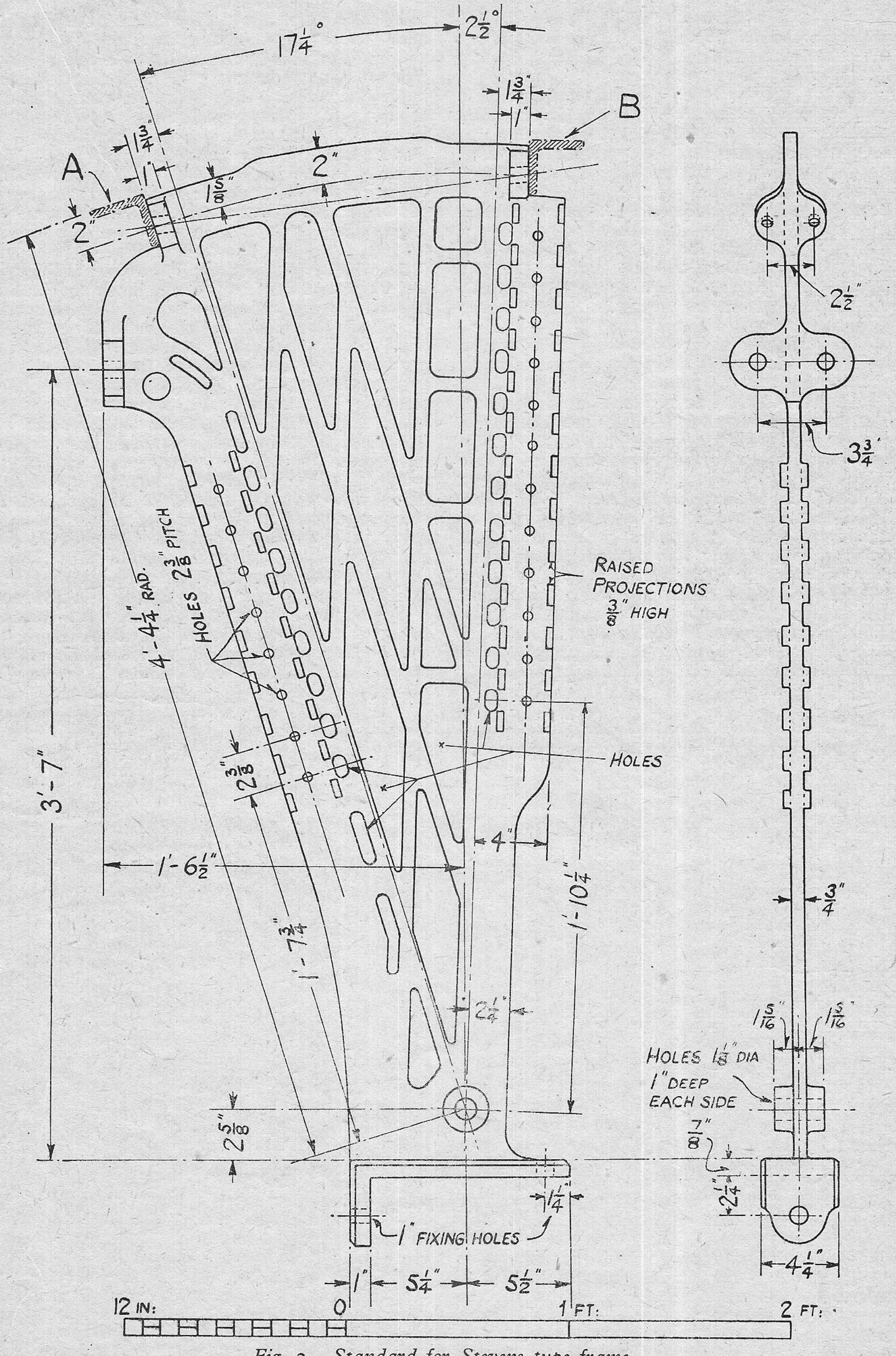


Fig. 2. Standard for Stevens type frame

words are usually given the "pulls," that is the levers needing to be reversed, in order that the particular lever in question may be pulled. In the case of a distant signal the "pulls" would be the number of the levers operating the "home," "starting" and "advanced starting" signals.

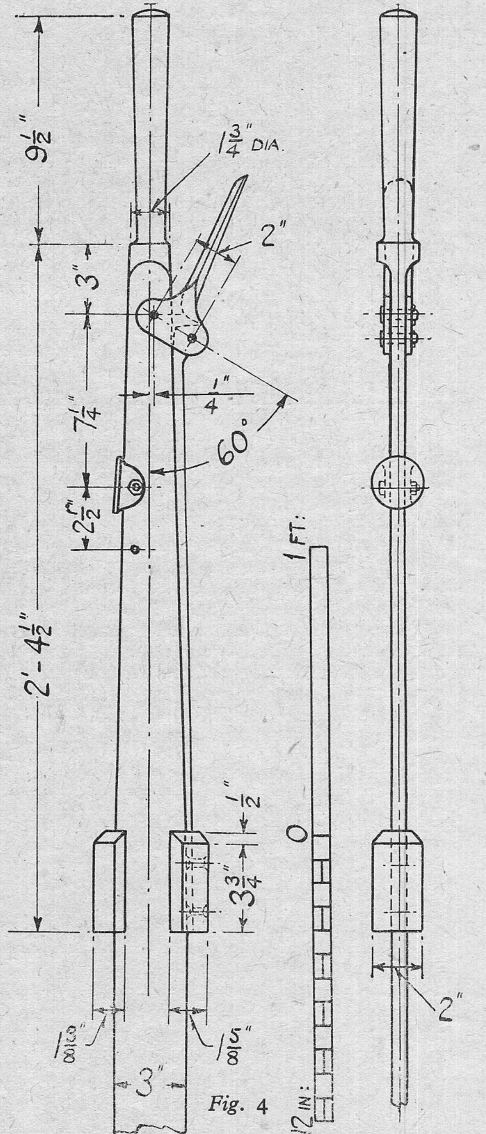


Fig. 4

In the next instalment I shall deal with the mechanism below the floor-plates of this locking-frame, but here I must add a few notes about the standards. These consist in the main of a cast-iron plate, ¾ in. thick, having flanges at the base for fixing to the main timber support, and lugs at the top for joining to the frame angles. The main plate is considerably lightened by a number of holes, the large diamond-shaped ones giving the appearance of some elaborate trellis in iron.

(*To be continued*)

Porosity in Gunmetal Castings

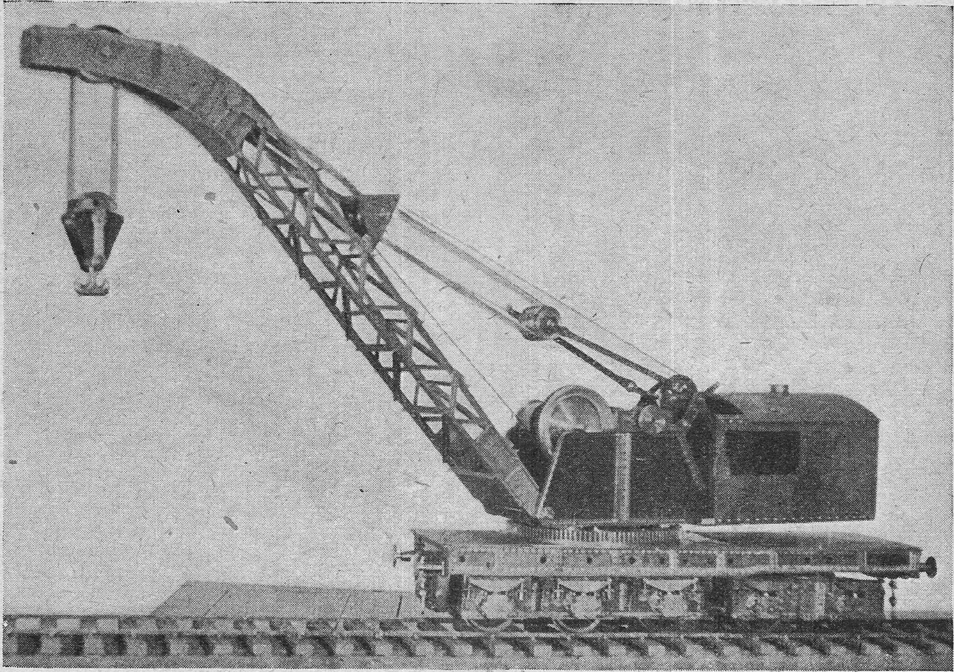
By A. J. T. EYLES

IT is fairly well known that gunmetal model castings are subject to various defects that are difficult to discover by surface inspection. The most common defect results from the inclusion of oxide in the metal of the casting. When the molten metal contains an admixture of oxides, owing to insufficient protection from the air, the castings are more or less porous. The best way to discover this defect is to make tensile tests on specimens cut from a coupon cast from the same melt, as the admixture of oxide is indicated by the greatly reduced elongation and the low ultimate strength. If a model engineer has not the facilities to make tensile tests, the presence of oxide can be indicated when a machined piece is bent, by a number of minute cracks which open on the outside of the bend; if the oxidation is extreme, the surface of the fracture will also have an abnormal colour. Oxidation of metal in the crucible is a very common defect in mixtures containing a high percentage of copper. A gunmetal model casting may be made of the correct mixture, and may show no surface indications of defects, and still be a honeycomb of metal filled with oxide.

A good plan in making gunmetal model castings is to add, when just about to pour, a very small quantity of phosphorus—about a salt-spoonful to every 28 lb. of metal. The utility of the phosphorous is not an alloying element in the same sense as tin is, but its value lies in its de-oxidising property. It cleanses from the oxides of copper and tin, rendering a gunmetal model casting sounder, more homogeneous, and more fluid. High phosphorus content, however, must be avoided, as it introduces casting difficulties and also produces low melting point constituents.

True gunmetals contain only copper and tin, the proportions being 88 or 89 of copper and 9 or 10 of tin. From 1½ to 2 per cent. of zinc is usually added, but only for rendering the alloy more fluid and the castings free from blowholes. The standard gunmetal of 88 copper, 10 tin, and 2 zinc, gives the highest tensile strength with good elongation. An erroneous idea appears to prevail amongst some engineers that a little lead is an improvement to the quality, permitting the castings to be made more sound. One effect of lead, however, is to very materially reduce the tensile strength and ductibility when cold. Hence the Admiralty specification for gunmetal stipulates that lead, if present, must not exceed ½ per cent.

Oxidation can be minimised by keeping the molten surface covered with charcoal, both when melting and pouring. When pouring, the surface need only be uncovered just at, or, nearby the spout, so keeping the air away from contact with the main surface. Only the best selected scrap or new metals should be used. The metal must be well stirred just prior to pouring. Bottom pouring with a good head is preferable, and good venting is essential.



A ¾-in. scale model breakdown crane

and is 5 ft. 9 in. long, height to top of funnel 10½ in., total weight in working order slightly under one cwt.

A Bogie Car

As a contrast to locomotives, the other photographs are intended to produce that twinkle in the editorial eye and help to refute the suggestion that model engineering is getting into a stereotyped groove, which the article on page 547, of THE MODEL ENGINEER for December 6th, 1945, hints at. The bogie-car is one of the train which is required to accompany "Percival Marshall" around the track. Ball-bearings are fitted in the wheels, the axles being non-rotating and coil springs are fitted on the axleboxes to support, fully sprung, a load of 300 lb. Bearer plates are fitted at the ends of each bogie stretcher which bear on the main frame stretchers and all looseness or wobble is eliminated, thus providing complete stability and solidness when passengers take their seats. The foot-rests are omitted in the picture, as facilities for a raised indoor track were not available when the photographs were taken.

Breakdown Crane

This is quite a departure from the groove and, in spite of its unfinished state, is the *pièce de résistance* of visitors to the workshop. It has been built so far conjointly with the L.M.S. engine, and represents a type of 40-ton breakdown crane as used on the British Railways. It is constructed to a scale of ¾ in. to 1 ft., and has hoisting, travelling, luffing and slewing motions.

The cylinders are to be ⅝ in. × ¾ in. stroke, with link reversing motion, and the boiler will be 3½ in. diameter by approximately 6 in. high. All the spur and worm gears have been machined and cut on a 3½-in. Myford lathe.

In due course, with the Editor's permission, I hope to be able to give readers a fuller description with, possibly, some pictures of the crane, together with its match-wagon and tool-van.

For the Bookshelf

British Railways, by Arthur Elton. (London: Collins, 14, St. James's Place, S.W.1). Price 4s. 6d. net.

This is one of the latest additions to Collins's "Britain in Pictures" series, and it gives a brief outline of the history of railways in Britain since about the year 1730. The text is interesting and informative, as well as being generally accurate. The eight full-page plates in colour and the thirty illustrations in black and white add much to the charm of the book. We would like to suggest that, if the book is reprinted, the G.W.R. "Cheltenham Flier" will be made to run in the right direction.

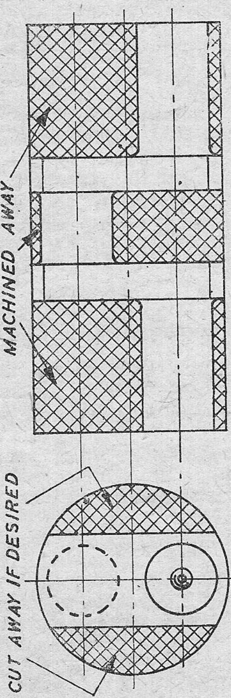


Fig. 1. Unbalanced crankshaft cut from solid round bar. (Cross-hatching shows metal to be removed)

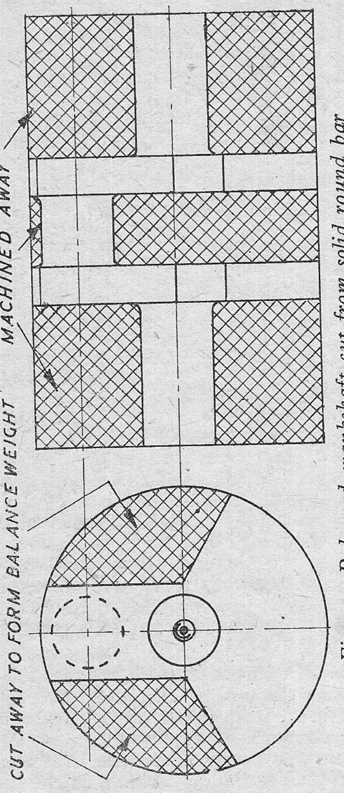


Fig. 2. Balanced crankshaft cut from solid round bar

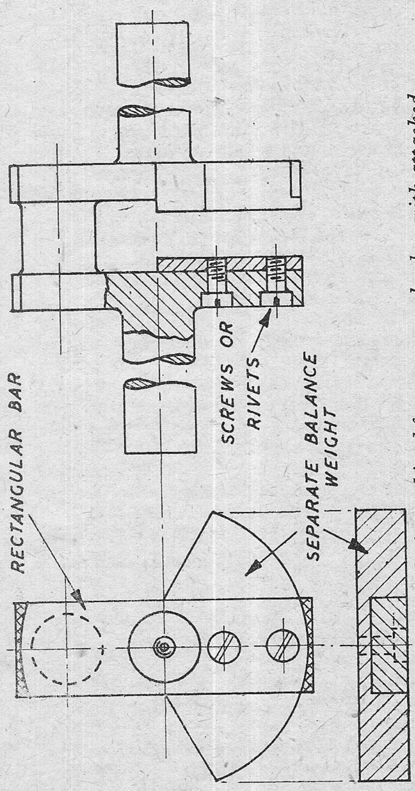


Fig. 3. Crankshaft machined from rectangular bar with attached balance weight

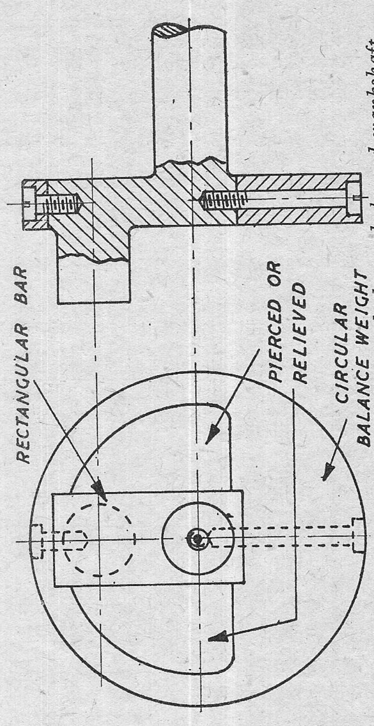


Fig. 4. Circular balance weight attached to unbalanced crankshaft. (Applicable either to overhung or double-bearing shafts)

It is always rather difficult to preserve fine limits of accuracy when working to a line, and further errors are possible when "spotting" with a centre-punch, and following up with a centre-drill. Slight errors in the location of the centres may produce angular misalignment of an order which would be scarcely measurable in the length of a full-sized shaft, but serious in a small one. There is little fear of a heavy shaft moving while being marked, but a small one may need clamping down, which is not always easy to do. I have encountered several cases where experienced model engineers have slipped up badly in marking-out shafts in this way.; the only possible way of avoiding errors is by observing the most meticulous care in all the marking and centering operations.

The use of a vernier height gauge will very much facilitate accuracy in setting out throw dimensions of a crankshaft, and if the centres are an equal distance apart on the two ends of the bar, alignment in one plane will be assured; but the most common error is angular misalignment, or "twist," due to misplacement sideways of one or more of the centre-points.

Turning a Solid Crankshaft

This is quite a straightforward procedure, and is clearly illustrated by Fig. 5, but it calls for some care, especially in the final stages, and may need special tools to deal with a narrow crankpin between deep webs. It is usual to rough down the main journals first to within about $\frac{1}{16}$ in. of finished size, as at (A), leaving sufficient metal at the ends to preserve the centres to mount the shaft for the second operation of turning the crankpin. It is sometimes worth while to go to the trouble of sawing and drilling away as much of the unwanted metal around the pin as possible, but many workers consider it quicker to do this entirely by turning. When mounted on the crankpin centres, (B) the work will be considerably out of balance, but this can be remedied to some extent by using a driving dog or carrier having a bias in the other direction, or weighted to suit particular requirements.

It is rarely practicable to use a tool the full width of the crankpin, except on a very rigid lathe; in any case, the cutting strain is very liable to distort the shaft, especially in the not uncommon event of a dig-in. A much more prudent policy is to use a narrow-pointed tool, and to proceed by easy stages; forcing the pace in an operation of this nature is usually asking for trouble. On account of the depth of the crank-webs, the tool must have a long reach, and right- and left-hand side tools will be required for finishing the inside faces of the webs. It may be necessary to change the tools several times in the course of the operation, and some delicate tool setting may be required for finishing the surface of the pin and the corners against each web, which should never be dead sharp, but always have a slight internal radius or "fillet."

After finishing the crankpin, the shaft is put back on the main centres to turn away the end flanges and finish the journal surfaces (C). If the webs are to be shaped to form integral balance weights, it is advisable to do this before finishing the journals, just in case there should be any risk of scarring the latter, by holding in the vice, or from any other cause. It is generally advisable to fit a "stretcher" piece in the gap between the webs, to avoid any possibility of distortion or spring under cutting pressure, or the wedging action of the centres, while carrying out the final turning of the journals. This block of metal should be made a neat push fit between the webs—the one thing it must *not* do is that implied by its name—and may be held in place by lightly tacking with solder.

Modern methods of producing full-sized crankshafts largely dispense with conventional marking-out processes. The shafts are usually mounted by chucking over the outside of the webs in traversing chucks, which can be set

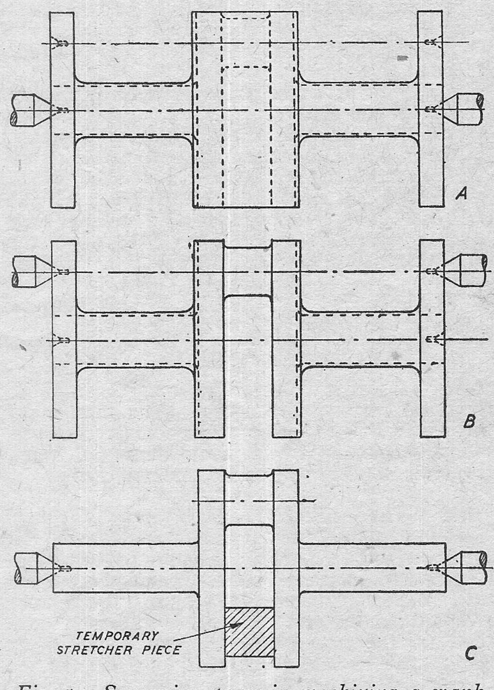


Fig. 5. Successive stages in machining a crank-shaft from solid bar

over to the required degree of eccentricity, while still preserving correct parallel alignment, and in some cases steadies, also capable of eccentric adjustment, are employed to support overhung weight. The amateur constructor is hardly likely to have facilities for carrying out work in this way, but several contributors to THE MODEL ENGINEER, including myself, have described methods of mounting crankshafts in vee-angle plates or simple eccentric turning fixtures, which facilitate machining and ensure true parallel alignment. These are generally more applicable to overhung crankshafts than those having bearings on both sides of the crankpin, but may be adapted to the latter by the exercise of ingenuity.

(*To be continued*)

A Set of Trammels

By "EIGHTEEN"

THE trammels described herewith will, it is thought, prove to be useful for most work undertaken by model engineers. Sizes have been kept as small as practicable, consistent with adequate strength, as lightness is a desirable feature in such a tool as a trammel.

Some form of micro-adjustment may be considered to be desirable, and details are given for such an arrangement. If this adjustment is included, increase the quantities given for details 3 and 4, by one off in each case, and substitute detail 7 for detail 1. Note that a 3/32-in. diameter hole is required in one only of detail 7.

The length of beam detail 5, has been given as 9 in., but it would, perhaps, be useful to make up a couple more, one, say, 6 in. long, and another one 12 in. long.

Mild-steel would be a suitable material for all details with the exception of the beam 5, which should be of silver-steel.

The machining of most of the components calls for little comment, but a few remarks concerning some of them may not be amiss.

Part 1. Chuck a piece of $\frac{3}{8}$-in. diameter bright mild-steel with about 2 in. protruding diameter face, centre and bring up tailstock to support material, turn down to $\frac{3}{16}$ in. diameter for 2 3/32 in., and to $\frac{1}{4}$ in. diameter for a further $\frac{1}{4}$ in., leaving a piece $\frac{3}{8}$ in. diameter, $\frac{5}{16}$ in. long. Form the 5/32-in. diameter, knurl the $\frac{3}{16}$-in. handle, and form a 1/32-in. chamfer.

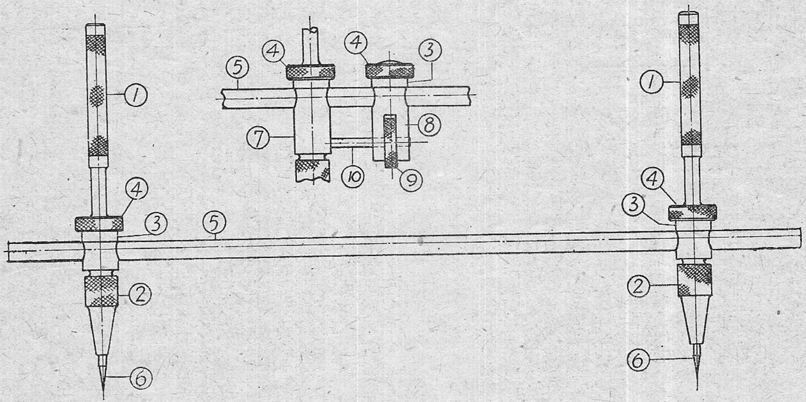
Cut the four 1/32-in. slots in the taper portion with a fine saw blade.

Part 2. Hold a piece of $\frac{3}{8}$-in. diameter mild-steel bar, with about 1 in. protruding, face, centre, and drill 5/64 in. diameter about $1\frac{1}{8}$ in. deep; open out with $\frac{1}{8}$ in. diameter drill for a depth of 1 in., drill and tap $\frac{1}{4}$ in. × 40 or 32 t.p.i. to 9/32 in. deep, using piloted tap for preference.

Turn down outside to 11/32 in. diameter for a distance of 11/32 in., knurl and form the taper portion, with the small end of taper nearest the chuck.

Part-off, reverse in chuck and, holding at the 11/32 in. diameter, face the small end to give a distance of 31/64 in. from the shoulder at the knurled diameter.

Part 7. Face square, one end of a piece of mild-steel, $\frac{3}{8}$ in. diameter, about 3 in. long, and, at $\frac{3}{16}$ in. from the end, drill a 3/32-in.



Arrangement of trammels. (Scale half-size)

from the jaws. Face, centre, drill 5/64 in. diameter, $\frac{3}{4}$ in. deep, turn down to $\frac{1}{8}$ in. diameter for a distance of $\frac{9}{16}$ in., and form taper (0.11 in. diameter at the small end), radius end, 3/64 in., as shown in drawing.

Turn down a further 9/32 in. to $\frac{1}{4}$ in. diameter and form $\frac{1}{16}$ in. wide undercut at shoulder.

Hold a $\frac{1}{4}$ in. × 40 (or 32) t.p.i. die in a tail-stock die-holder, and screw the $\frac{1}{4}$ in. diameter portion.

Remove from chuck, and drill and ream the 7/32-in. diameter hole at 15/64 in. from the shoulder next the threaded part.

Reverse in chuck and, holding at the $\frac{3}{8}$-in. hole, using a vee-block, and, at $\frac{9}{16}$ in. from the end, drill and ream the 7/32-in. diameter hole.

Hold the bar under the tool-clamp on the lathe, and mill the $\frac{1}{8}$-in. wide slot at right-angles to the drilled holes, 15/32 in. deep from end of bar.

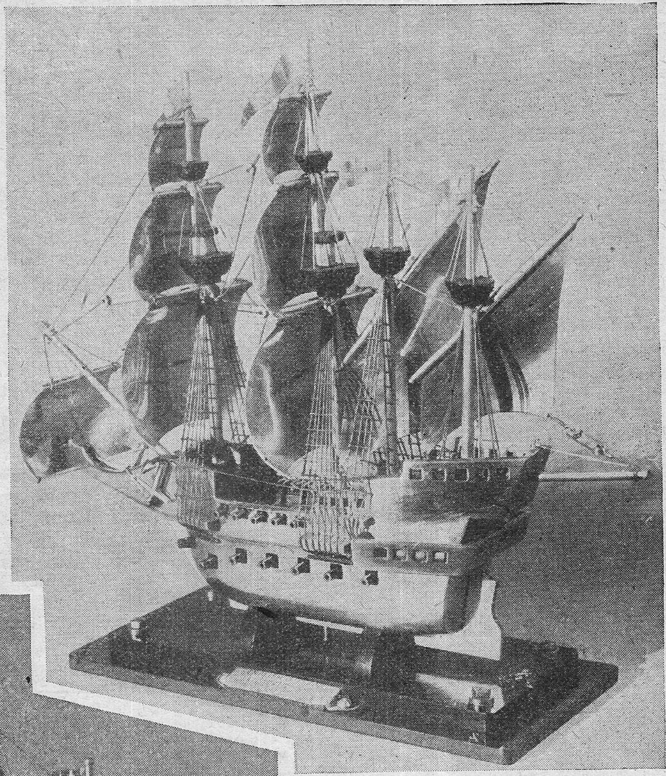
Hold bar in the three-jaw chuck, turn down to $\frac{1}{4}$ in. diameter by $\frac{1}{4}$ in. long and screw $\frac{1}{4}$ in. × 40, or 32-t.p.i. Form radius at end.

Part 10. Make the short threaded portion a tight fit in detail 7.

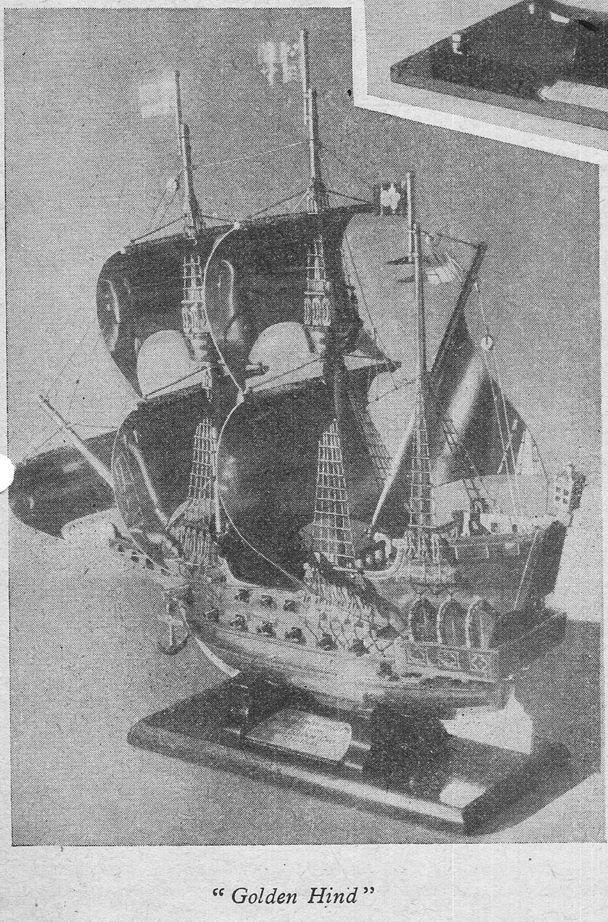
The remaining details are all quite straightforward and should not present any difficulties.

Ship Models in Metal

By S. PARKER



"*Elizabeth Jonas*"



"*Golden Hind*"

I HAVE always been a great admirer of the models of the fine old galleons of the Elizabethan period. I have seen many constructed of wood, etc., but I have not seen or known of any constructed of metal, such as aluminium, bronze, etc. I have always had the urge to build one entirely of metal, and I realised that it would require a fair amount of skill and patience to build a model galleon of metal to scale, and with plenty of details.

With thirty years' experience as a toolmaker, fitter and machinist, I had a lot in my favour. So, with a fair collection of scrap aluminium and copper, some kindly given to me by friends, and with plans of the *Elizabeth Jonas*, I ventured to build one 11 in. in length, which was approximately two-thirds of the actual plan scale. Of course, a new set of details, sketches and plans were necessary.

As for construction, the hull, bulwarks, keel, decks, and gallery, etc., had to be built up with pieces of aluminium, since castings could

"Hielan' Lassie"

By "L.B.S.C."

A $3\frac{1}{2}$-in. Gauge L.N.E.R. 4-6-2

At the time of writing, I don't know definitely if the casting merchants will be able to produce the complete bogie as a single unit, only needing axleboxes, springs and wheels to complete; but if they can, it is going to save a lot of work. I might add here, for beginners' information, that one-piece castings for the main components of a full-sized locomotive have been increasingly used overseas, especially in U.S.A., where it is no uncommon thing to find an engine having the main frames, stretchers, cradle, pilot and drag beams, cylinders, smokebox saddle, air reservoirs, and all the lugs and brackets on which the "trimmings" are hung, all in *one single casting*, which is known as a "locomotive bed." You can easily realise the vast amount of time saved in erection work! Anyway, if our one-piece bogie does eventuate, all it will need will be a clean-up with a file, and axleboxes, springs and wheels adding as described below.

Alternatives

A plate-framed bogie may have either a cast or built-up centre, and I am showing illustrations of both kinds, so that you may take your choice. In either case, the frames need two pieces of $\frac{1}{8}$-in. steel, 7 in. long and $1\frac{5}{8}$ in. wide, which are marked out, temporarily riveted together, and cut to outline, same as the main frames. The openings for the axleboxes should be set out from the centre of the plate, first marking this with a vertical line, then drawing two more at a distance of 2 11/32 in. on either side of the first one. Set out the $\frac{5}{8}$ in. by $\frac{7}{8}$ in. openings on these lines, as shown in the illustration; the bottom of the opening should be $\frac{3}{16}$ in. from the bottom line of the frame. A recess $1\frac{3}{4}$ in. long and $\frac{1}{8}$ in. deep will be needed in each frame, whether a cast or plate centre-piece is used; if you are adopting the latter, only drill the top row of screw-holes, but keep to the $\frac{1}{2}$-in. spacing. The curved parts of the frame, correspond to the diameter of the bogie wheels. The guard-irons may be riveted on now, if you like, to save work later on; they are made from $\frac{1}{16}$-in. steel, and bent outwards at the bottom to $3\frac{1}{2}$ in. between, so that they will overhang the rail-heads when the bogie is erected. Be careful to drill the No. 30 holes for the spring-pin lugs in the right places; I have not shown the holes separately on the drawing, but only the lugs in position. The holes are $\frac{3}{4}$ in. from the bottom line of the bogie-frame, and $\frac{11}{16}$ in. either side of the centre of the axlebox openings. Tip: the latter may be roughed out in double-quick time with an "Abrafile"; drill a $\frac{3}{16}$-in. hole in one corner of the marked-out place, poke the "Abrafile" through it, and hook it into the clip on the hack-saw frame. You can then grip the bogie frames in the vice, and go right around the outline of the opening without any necessity for shifting the "Abrafile" in the hack-saw frame, as it cuts in any direction, and will walk through the steel as easily as a fretsaw through wood. The sharp corners of the openings can be finished with a square file. The horn-cheeks are made from brass angle and riveted on with 3/32-in. round-head rivets, charcoal-iron for preference. As $\frac{3}{8}$ in. by $\frac{1}{4}$ in. by 3/32 in. angle is not a regular commercial size, and $\frac{3}{8}$ in. by $\frac{3}{8}$ in. by 3/32 in. is, the latter can be utilised by filing off the odd $\frac{1}{16}$ in. Eight $\frac{7}{8}$-in. lengths are needed.

The lugs through which the spring-pins pass, are made from $\frac{3}{16}$ in. by $\frac{1}{4}$ in. steel. Chuck truly in four-jaw, face the end and turn a pip on it $\frac{1}{8}$ in. diameter and a bare $\frac{1}{4}$ in. long. Part off a full $\frac{5}{16}$ in. from the shoulder; repeat operation eight times. Drill a No. 30 hole in each, $\frac{3}{16}$ in. from the shoulder, and round off the end with a file. Slightly countersink the holes on the outside of the frames, insert the shanks of the lugs, rivet over, and file flush, as shown in the plan drawing.

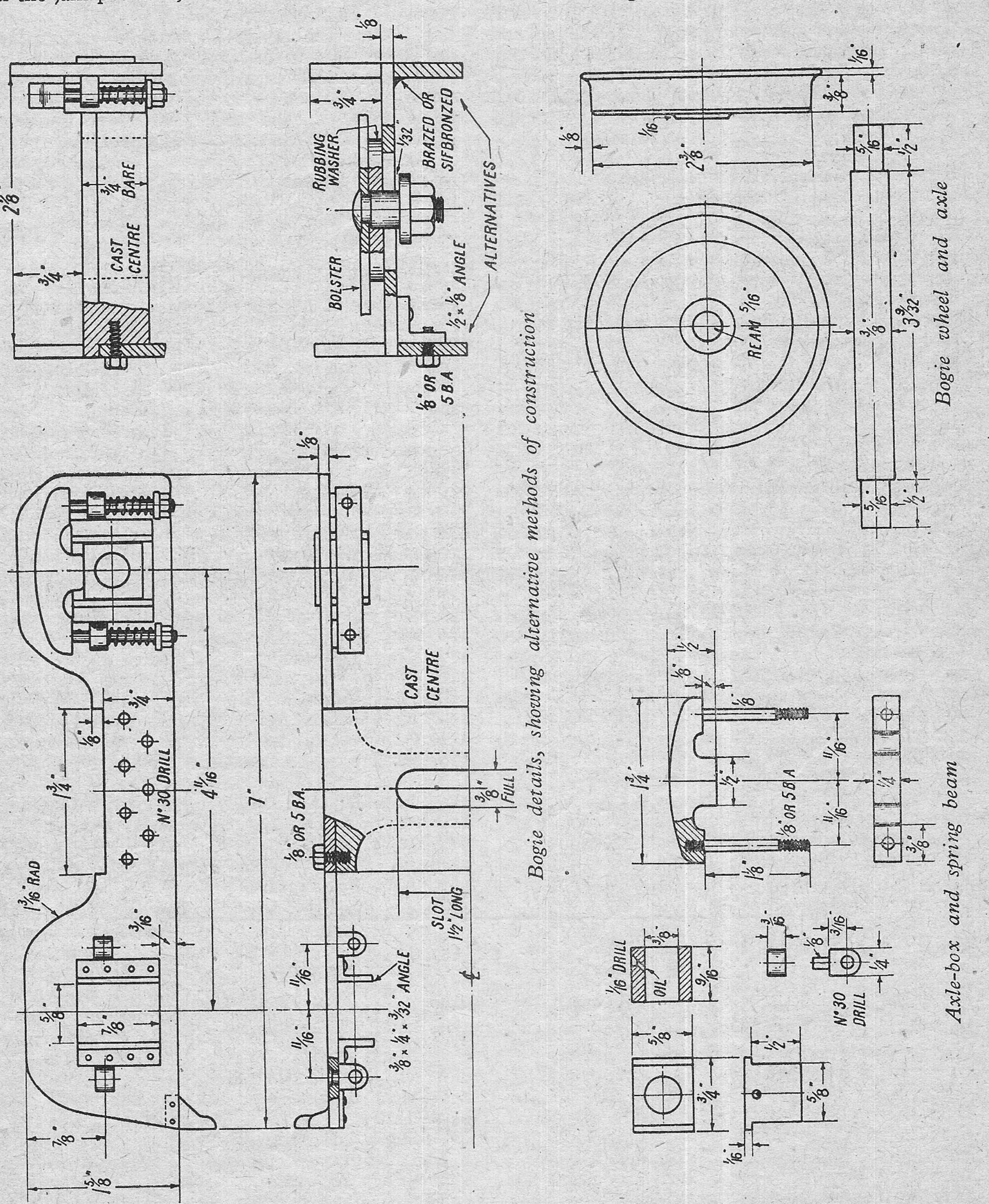
Bogie Centre

If a casting is used for the centre-piece, it will have the slot for the bogie-pin cored in, and a flange at each side to fit in the recesses in the bogie frames. The slot can either be cleaned out with a round file, or end-milled. In the latter case, the casting must be either clamped to a vertical slide, or to the top of the slide-rest, so that the slot coincides with the lathe centres. The casting is then fed on to the end-mill in the chuck, by moving the top slide or saddle, whichever is the most convenient, and traversed across by means of the cross-slide. If a vertical slide is used, a piece of wood packing should be put between the slide and the casting, otherwise the cutter will mess up the surface of the slide when it breaks through. I gave illustrations of how to set up for end-milling, in the notes on "Petrolea," so need not repeat them here.

The ends of the casting, where they are attached to the bogie-frames, are just like the sides of a single-flanged axlebox, the flat part butting up against the frame, and the flange entering the recess; see sectional illustration. They are machined in exactly the same way, too; clamp the casting under the tool-holder, with the part to be machined at right-angles to the bed, and traverse across an end-mill not less than $\frac{5}{8}$ in. diameter, in the three-jaw. If a milling-machine or planer is available, simply clamp the casting side-up in the machine-vice and operate either with a cutter about 3 in. diameter and $\frac{3}{4}$ in. wide in the miller, or a round-nose tool in the clapper-box of the planer, finishing out the sharp corner with a knife-tool. If neither machine is available, and your lathe is not big enough to tackle a milling job, or you have not the necessary cutter, do what young Curly was obliged to do in days long past—use a file. This is a wonderful tool, when the right person is at the handle end!

To erect, set the casting between the bogie-

should be quite free to slide. The full-size engines have swing-link bogies; and had it not been for the extra-long wheel-base, due to the divided drive, I should have specified a swing-link bogie for the "Lassie." The wasp in the jam-pot here, was the fact that the curves the friction of the large boss on the cast bolster, or the rubbing washer on the built-up one, being sufficient to prevent any hunting or nosing when the engine runs at high speed on a straight road. The bogie will carry its share of the load all right, seeing that the inside cylinder is right



Bogie details, showing alternative methods of construction

Bogie wheel and axle

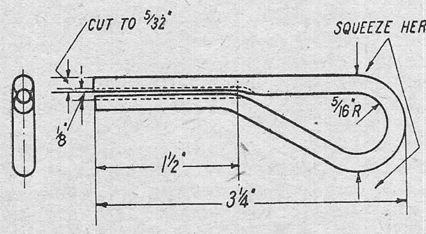
Axle-box and spring beam

on the average small railway are akin to those on a colliery siding instead of the big sweeping curves on the L.N.E.R. main line, and a swing link bogie wouldn't have given sufficient freedom. For that reason I adopted the sliding-bogie. and did not include any side control springs, over the bolster. The plain part of the bogie-pin on the cast-bolster should project slightly, say about 1/32 in. below the bottom of the slot on a cast bogie centre. If a plate bolster is used in conjunction with a cast bogie centre, the turned pin should be long enough to project the same

Letters

A File Handle

DEAR SIR,—The needle file handle described by J. A. Mitchell in THE MODEL ENGINEER, March 23rd, 1944, has proved to be a very useful article. I have simplified its construction by omitting the clamps and drilling the channels for the tang of the file. Using $\frac{3}{16}$ in. diameter B.M.S., it was found that there was sufficient spring tension to hold the file securely after



squeezing the bow of the handle inwards in a vice. A flat was first filed on the inner surfaces, then a drill was carefully run down the length.

The security of this device is ample for quite heavy going, and the interchange of various files is a speedy operation.

Yours faithfully,

Putney. G. WATSON.

Old Micrometers

DEAR SIR,—I was very interested to learn from Mr. Dupont's letter in your issue of January 24th, that micrometers like Mr. White's were in use in the tinplate industry, but I must disagree most strongly with his statement that the Brown & Sharpe instrument is almost exactly identical with the Whites—for the following reasons.

(1) *Difference of material.* Mr. White's is largely made of brass. The Brown & Sharpe is of high carbon steel.

(2) *The measuring screw is internal in the Brown and Sharpe, and external in Mr. White's.*

This should be enough to show that Mr. White's micrometer is old, as external screws are now only found on those made for rough usage—in schools, etc., and for rolling mill micrometers—as used in Sheffield and South Wales. Both are of comparative low accuracy and unfitted with ratchet gear.

If Mr. Dupont will turn to the front pages of the Brown & Sharpe's catalogue he names (page 5, I think) he will find a very good short history of the micrometer there. He will see that external screws went out about 1880—in fact Brown & Sharpe were one of the first to make commercially an internal screw micrometer. They and Starratts led the small tool market at that date and any improvement would represent the best practice at the time.

(3) *The ratchet gear is different in each case.* The Brown & Sharpe micrometer has the standard Brown & Sharpe type (as fitted to their ordinary micrometers) and separate from the main drum. Mr. White's is in the main drum, and cannot be removed without spoiling the instrument.

(4) *Marking.* All Brown & Sharpe tools are beautifully marked and have been since the firm started, in 1860. If Mr. White's micrometer had been of their manufacture it would have been so marked. I am not sure whether Mr. Dupont implies that Mr. White's micrometer is of Brown & Sharpe manufacture or not (this does not destroy, however, the strength of the other three reasons).

(5) *The difference in pitch of the measuring screw.* This has already been noted by Mr. Dupont, but is a fact, nevertheless.

As a further point which might be of interest on this subject is that I remember my father telling me he had seen one of the "Système Palmer" micrometers of 1860, at Brown & Sharpe's, when he visited them in 1905. This was very like a normal metric micrometer, but with an external screw, and was supposed to be the one seen by Messrs. Brown & Sharpe when they were over in France, and started them off on making their own micrometer.

Of course, previous to 1860, the shape of the micrometer as we know it had not emerged. I am at present engaged on research on this point. I have counted six forms, viz.: (1) Internal screw, like more modern micrometers. (2) External screw, like more modern micrometers. (3) Nut working on accurate screw and measuring between jaw on nut and fixed jaw—like Horstmann micrometer of 1856. (4) Two nuts on accurate cone threads—one thread of slightly different pitch to the other and the jaws fitted to the nuts. This form is rare, but shown in the Table of Mechanical Movements, by J. Fuller, of Boston, 1851. (5) Worm and wormwheel as in Wentworth's Millioneth's Measuring Engine of 1855. (6) Optical methods—adaptations of the astronomical "micrometer" man in the 18th century.

Can any reader add to my list of types?

Yours faithfully,

Beckton. J. A. WILLIAMS, B.Sc., A.M.I.Mech.E.

Ciné Projector Design

DEAR SIR,—Might I be allowed to comment on the letter about Ciné Projector design, signed "Excogitate," in your January 3rd issue?

Your correspondent states that he does not like the claw movement, a sentiment with which I heartily concur. He then goes on to describe the motion on his own projector. He states that he uses a 12-slot Maltese-cross movement. I suggest that here his judgment is faulty. Of course, an intermittent motion of that particular design is quite sound mechanically, but will not fulfil the special requirements of a ciné projector with complete efficiency. In the absence of any statement on this point by "Excogitate," one is compelled to assume that he selected a 12-slot Maltese cross instead of the more usual 4-slot type, in order to avoid the necessity of gearing down to his 12-tooth film sprockets.

There seems to be a fallacy so obvious here that I am wondering how "Excogitate" has failed to notice it, because, emphatically, a

The Society of Model and Experimental Engineers

On March 16th there will be a "Brains Trust" meeting, when a representative team of members will endeavour to provide a satisfactory answer to questions of a technical nature put to them by other members. The meeting will begin at 2.30 p.m.

Will members make a special effort to attend this meeting and send in to the Secretary such questions in advance that they would like to be answered. These questions would be submitted to the questionmaster beforehand, but the "Brains" would not have prior notice of what questions they would have to answer.

The success of this meeting will depend on the number and variety of questions submitted and members are asked to help in this.

Full particulars of the Society may be obtained from the Secretary: 69, Chandos Avenue, Whetstone, N.20.

The Bristol Ship Model Club

A meeting was held on February 12th, at Prince Street.

The chief item of the evening was Mr. Coote's fleet of miniatures of modern warships. The workmanship of this series could not be bettered, and members were very interested in Mr. Coote's paintings of sea scenes, including one admirable picture of the *Bismark* in action. Mr. Poole's model *Robert E. Lee* was also on show.

A full list of models owned by the members is being compiled by Mr. N. Poole (librarian).

Notice was given of the annual general meeting of the club, on March 12th, 1946, at 7.0 p.m. Anyone in the district interested, please write to the Hon. Secretary: ARTHUR W. KIRTON, 29, New Fosseway Road, Knowle, Bristol 4.

The Kent Model Engineering Society

Meetings recently held have been well attended, and new members are enrolling, but we have plenty of room for more.

The Society took possession of its new quarters in Crantock Road, Catford, on March 1st, and the first meeting to be held there will be on March 11th.

Meetings have been arranged as follow:—March 11th, "Leda III," by Mr. E. Vancer; 18th, "Principles of Tool and Cutter Grinding," by Mr. E. Sidey; 24th, Sunday Track Run, 11 a.m.; 25th, Display of Work. April 1st, Rummage Sale.

Visitors are always welcome and particulars of membership can be obtained from: The Secretary: F. H. GRAY, 3, Jutland Road, Catford, S.E.6.

The Staines and District Society of Model Engineers and Craftsmen

Arrangements have been made which enable a meeting to be held the third Thursday each month at the Links Hotel, Stanwell Road, Ashford, at 7.30 p.m. This is in addition to the meetings held at the Phoenix Hotel, Staines, thus making our meetings fortnightly. A splendid show of models was given at our last meeting, including gauge "1" "Schools" class locomotive; parts for 14 c.c. petrol engine; boiler for 5 in. gauge G.W. Tank; 1 in. scale road-roller; 4-way tool-post; small milling vice, and an interesting old watchmaker's milling machine. A horizontal flat-twin uniflow engine was also shown under steam.

The first exhibition of the above society will be held at the Tothill Club, Tothill Road, Staines, on Saturday, March 30th, open to the public from 10 a.m. onwards.

This will cover all branches of model engineering and allied crafts, prizes in cash to be awarded for the best exhibits in open competition.

Entry forms and details will be gladly sent to club secretaries and lone hands on request, and we should appreciate the offer of models on loan.

The Malden Society are assisting with a portable track, locomotives, etc., Closing date for entries, March 23rd.

Hon. Secretary: RONALD F. SLADE, 166, Kingston Road, Staines, Middlesex.

Eccles and District Model Engineering Society

On Sunday, February 17th, a track meeting was well attended; locomotives running were Mr. H. Chapman's $3\frac{1}{2}$-in. gauge "George V," Mr. J. W. Clarke's 0-6-0 "Molly," and 2-8-0 U.S.A. M.O.S. Starting Sunday, March 17th, a Machining Quiz, chairman, Mr. R. O. Harper; it is hoped to cover all phases of machining during this series.

Hon. Secretary: J. W. CLARKE, "Egnet," Rothiemay Road, Flixton.

Exeter and District Model Engineering Society

A general meeting of the above took place on February 2nd, at 6.30 p.m., at 49, Prospect Park, Exeter, the home of our president, Mr. E. O. Harding.

After business, a member, Mr. Pim, gave us a talk on "Pattern Making and Moulding," illustrated by several patterns he had made, to demonstrate more clearly. All questions relating to castings, etc., were answered promptly and all present were delighted with the talk. Can anyone help us to obtain a room and grounds?

Hon. Secretary: GEO. W. BELL, 44, Retreat Road, Topiham.

Burnley and District Model Engineering Society

The next meeting will be held at Accrington, in the Rechabites' Hall, Abbey Street, on Friday, March 8th, at 7.30 p.m. There will be a lecture by a member.

Joint Hon. Secretaries: J. D. MEE, 2, Windsor Avenue, Church, Accrington. A. BATEY, 36, Moseley Road, Burnley.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Maidenhead, Berks.

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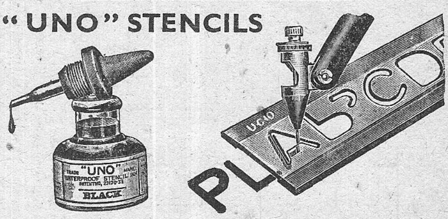

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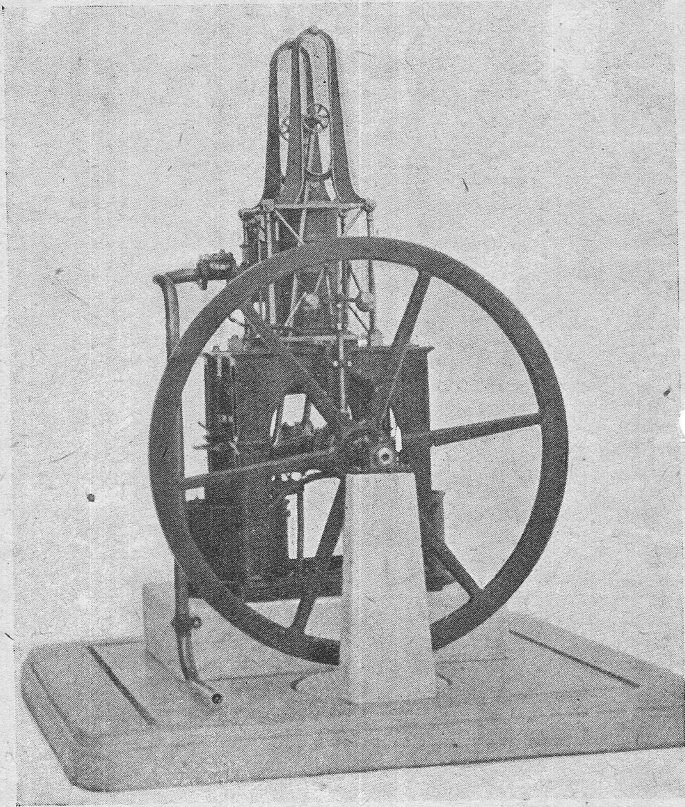
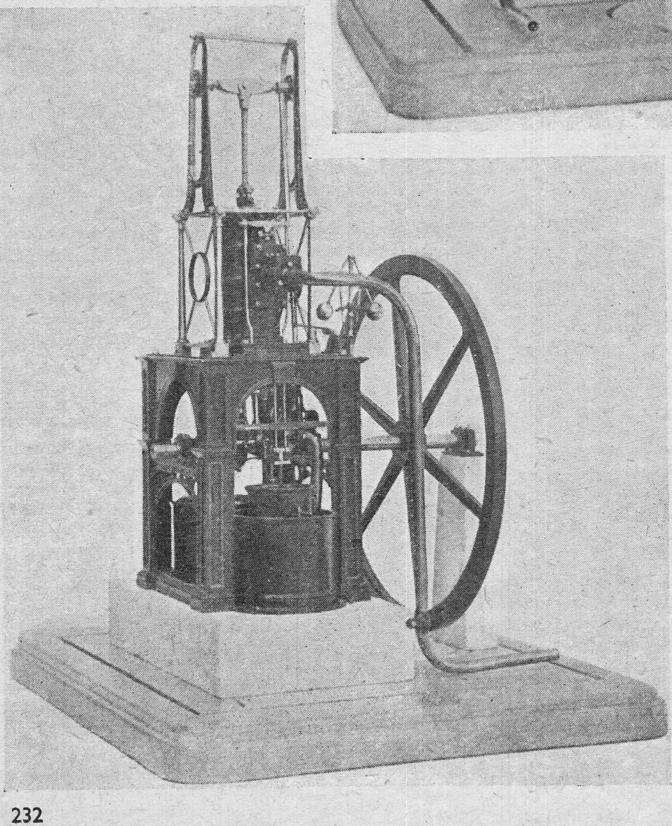
A Maudslay Table Engine

By L. G. BATEMAN



THE reproduced photographs show a model of a "Maudslay" table engine that I completed about two years ago. It was built from drawings in Tredgold's *A Treatise on the Steam Engine*, and is $\frac{1}{16}$-in. to 1 in. scale, *i.e.* $\frac{1}{16}$ of full size.

With the exception of the valve-gear, it is very faithfully to scale. The exception mentioned is that the valve shown in the drawings is a conical plug-valve, which the late Mr. H. O. Clark told me was not typical of these engines; so I changed it to a slide-valve.



The engine is, of course, a working model, though it has only been run on compressed air, hence the condenser has not been proved. The circular grating visible under the flywheel is a silica-gel air-dryer to keep the air in the case dry.

The successor to this engine is a $\frac{1}{8}$-scale model of the Easton and Amos "Grasshopper" engine in South Kensington Museum.

These engine models are the beginning of, I hope, many such of historical interest and are to be followed perhaps by a beam engine, a diagonal paddle steamer engine and a model of the oscillating cylinder paddle engines of the steamer *Lord of the Isles*—about a ten-year programme, so far!

field for research, and for the making of models that are not only fascinating mechanical mechanisms, but which will eventually prove to be of historic value.

It would, of course, be impossible in the space at my disposal, to provide drawings of every detail of the frames to be described. As with working models of steam locomotives, the builder will often find that it is preferable to depart somewhat from an exact scale reduction of certain parts, and so the drawings accompanying these articles have been prepared in such a way as to indicate the principle on which each mechanism is based and to give the leading dimensions of the principal members. The different types of locking-frame have been classified according to their design rather than by the railway companies using them. Many of the old, pre-grouping railway systems used apparatus that represented no more than comparatively minor varieties of the same basic design ; and as the signal manufacturers brought out improved patterns, so these came to be adopted, thus resulting in the use of several types of locking-frame simultaneously on the same railway. Some lines, notably the G.E.R., would seem to have awarded successive contracts to the lowest bidder regardless of previous installations and such matters as standardisation ; as a result, examples of almost every manufacturer's apparatus can now be seen in signal-boxes in various parts of East Anglia. Three companies, the London & North Western, the Midland, and the Great Western, designed locking frames of their own, each of a highly distinctive and original character ; yet on careful analysis, even these, with the possible exception of the L. & N.W.R. type, will be found to incorporate one or other of the basic mechanisms pioneered by the early signal manufacturing firms. So much by way of introduction. The first frame to be described now is that of Stevens and Sons Ltd., such pride of place befitting the introducers of tappet locking.

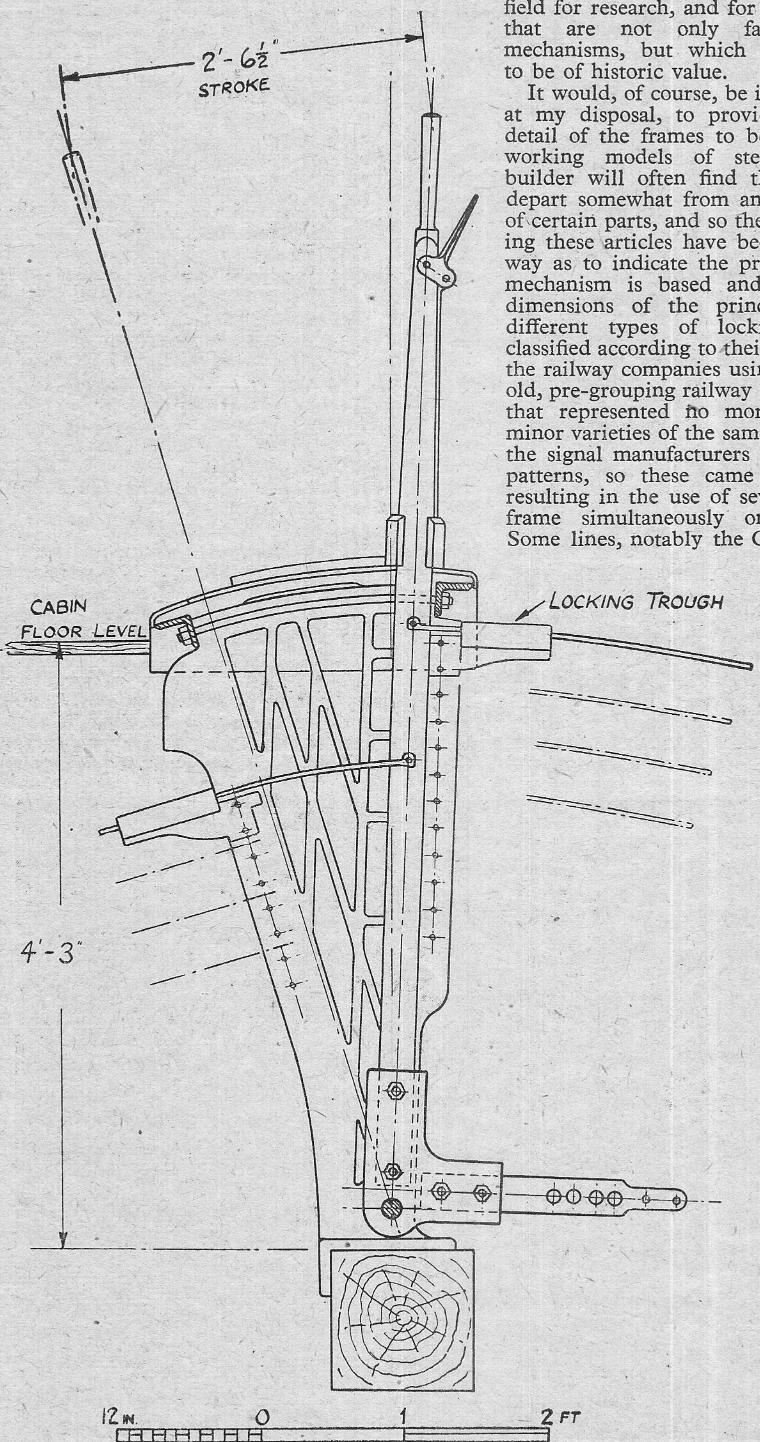


Fig. 1. Cross-section of Stevens "Glasgow" type locking frame

No. 1. The Stevens Apparatus—Part I

I have chosen the Stevens frame with which to commence this series of articles, partly on account of its historic importance as being the first to include tappet locking. But an even stronger claim to priority is that it is one of the simplest interlocking mechanisms ever constructed. The firm, in the course of its history, put on the market several different types of frame; the one I have chosen for description is that built in the Glasgow works, and widely used on all the Scottish lines, except the Highland. In England, the London and South Western used Stevens frames, and the famous "A" box, at Waterloo, was so equipped; the English pattern varies only in certain details from that now to be described.

Fig. 1 shows a cross-sectional elevation of the frame. It is supported upon a wooden beam, 12 in. square, which runs the full length of the frame, and is built into the signal-box structure. The mechanism is carried on a series of standards, the detail of which is shown in Fig. 2. These are spaced so as to suit the number of levers in the particular frame, the maximum number of levers between any two standards being eight. Thus, in a 64-lever frame there would be nine standards, while in frames where the total number of levers is not a multiple of eight, the make-up is arranged to include 7-lever, and 6-lever bays, as required. Before proceeding to consider the various details from the dimensional point of view, it will be convenient to go over the salient features of the apparatus so that the function of each part is fully appreciated.

block rests normally behind the rear end of the raised tongue on the floor plate, shown in Fig. 3, and the act of raising the catch-block lifts it clear of the tongue and enables the lever to be pulled. There is a floor-plate between adjacent levers; these floor-plates are made easily removable, for an important necessity in a locking-frame is that any one lever shall be capable of being removed, if necessary for alterations or other repair work, with the least amount of interference to the rest of the frame.

From Fig. 3 it will be seen that the levers are pitched $5\frac{1}{4}$ in. apart; the floor-plate is of cast-iron, having a general thickness of $\frac{3}{8}$ in., and fixed with $\frac{1}{2}$ in. bolts to the frame angle. So as to avoid any fixing above the floor-plate on which the signalman is likely to catch his foot, these fixing bolts have round heads and are provided with a nib on the underside of the head which engages in a slot in the floor-plate casting. The detail of that portion of the lever which is above the floor-plate is shown in Fig. 4. Below the floor the lever is parallel, 3 in. wide, but above the floor it tapers uniformly to a width of $1\frac{3}{4}$ in. immediately below the handle. The catch-block fits round the lever on three sides, and the opening on the fourth side is made wide enough to enable the block to be slipped over the narrowest portion of the lever just below the point where it swells out to $1\frac{3}{4}$ in. diameter at the base of the handle. The lever is $\frac{5}{8}$ in. thick throughout. The catch-handle in actual practice is made in malleable cast-iron; the handle portion is carefully rounded, smoothed and polished, like the lever handle. The handle

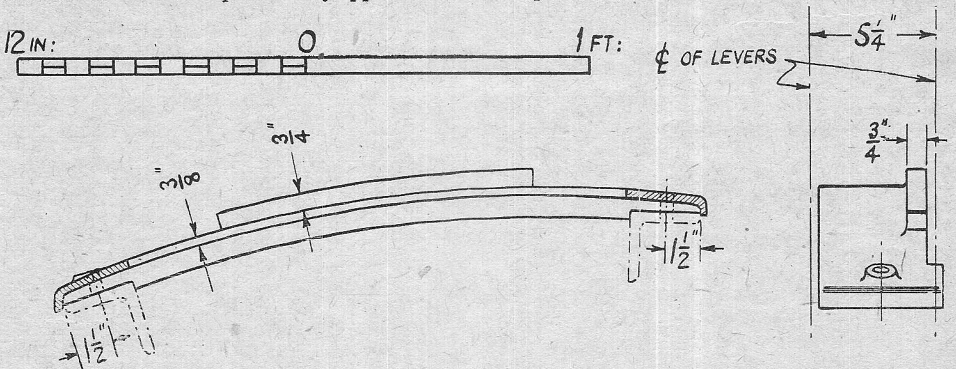
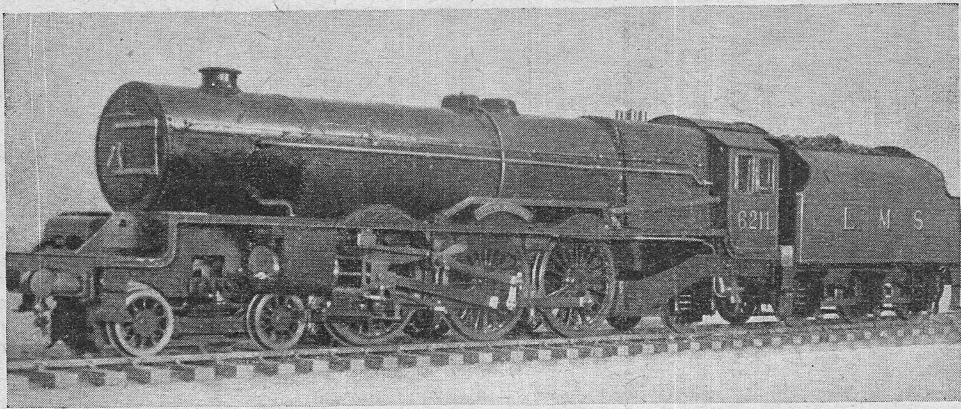


Fig. 3. Floorplate, Stevens type frame

Referring again to Fig. 1, two angle irons, seen in cross-section, will be noted; they are also shown at *A* and *B*, in Fig. 2. These angles, which are 3 in. × 3 in. × $\frac{1}{2}$ in., run the entire length of the apparatus and form the framing that secures the standards at their upper end, and on which the curved floor-plates are assembled. Each standard is fixed to the frame angles by two $\frac{1}{2}$ in. curved rods, which are screwed at each end. The floor-plate is shown in Fig. 3, which drawing should be studied in conjunction with the general arrangement, Fig. 1. The lever is latched in its normal or reverse position by the catch block, which is lifted when the signalman grasps the catch-handle, preparatory to pulling the lever; the catch-

is connected to the catch-block by a wrought iron strap, having a forged-up eye at the upper end, and riveted to the catch-block at the lower.

Below the catch-handle, on the front of the lever, is a circular badge giving the number of the lever in the frame. The number is painted on in figures 1 in. high. The additional hole, $2\frac{1}{2}$ in. below that for the number plate, is for fixing the designation plate. The size and shape of this varies according to the inscription; they are usually $1\frac{1}{2}$ in. wide, semi-circular at the top and square at the bottom. A typical plate is 6 in. high and is fixed with two bolts pitched 4 in. apart. On this plate appears the description of the lever, such as "Up Main Distant," or "Down Relief Inner Home," and below these



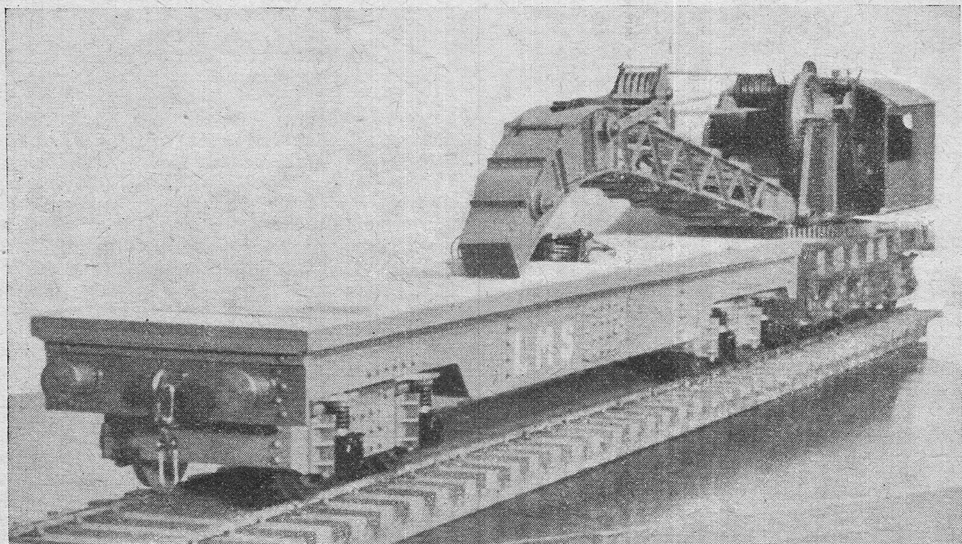
"Percival Marshall"

By G. R. HILL, A.M.I.Mech.E.

IT is more years than I now dare to think of since the miniature representative of the L.M.S. "Princesses" began to take shape. Two pieces of $\frac{1}{8}$-in. mild-steel on the workshop floor, which eventually had the engine built round them, started the ball rolling, and now, seven years later, in 1945, here is "Percival Marshall," my wish to pay my small tribute to the friend and counsellor of model builders the world over.

The engine is constructed as nearly as possible to the famous prototype, and has four cylinders, 1-in. bore by $1\frac{3}{4}$-in. stroke, with Walschaerts valve-gear. The boiler is brazed throughout and has twenty fire-tubes and three superheater tubes with spearhead elements. Driving and coupled wheels have built-up balance weights. Four safety-valves of Ross "Pop" design are fitted, pressed to 135 lb. per square inch working pressure. Feedwater is supplied by an injector under the cab, with an emergency double-acting hand pump in the tender. Steam brakes are fitted to the engine, and hand-operated brakes on the tender. Details as on the prototype, such as oval buffers, etc., have been fitted with a view to thoroughly satisfying "L.B.S.C.'s" old friend "Inspector Meticulous."

The engine is built to a scale of $\frac{3}{4}$ in. to 1 ft.,

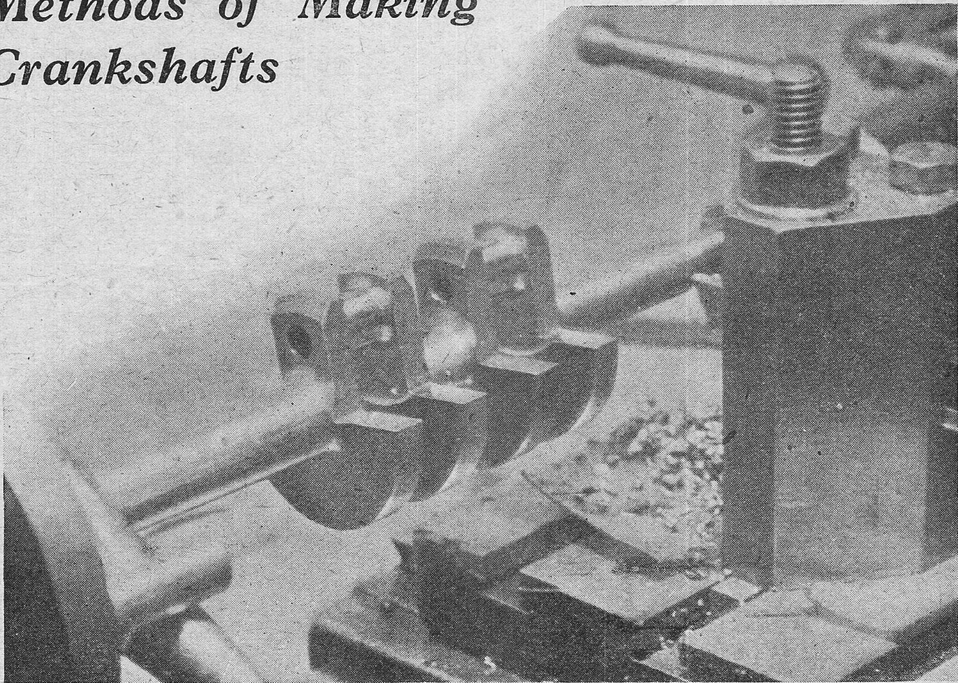


Out of the groove!

Petrol Engine Topics

By E. T. WESTBURY

Methods of Making Crankshafts



The two-throw crankshaft of Mr. Bradley's "1831" engine set up on main centres for finishing the journal surfaces

ON several occasions I have been asked by readers—presumably beginners in model petrol engine construction—to inform them what is "the best way to make a crankshaft." The fact is, however, that there is no "best" way to make a crankshaft; but there are several equally sound methods of doing so, the choice of which is influenced by questions of design, materials and facilities. There are also several commonly-applied methods which, if not actually unsound, are at any rate very liable to error, and therefore not to be recommended, especially to the inexperienced machinist.

The crankshaft of a petrol engine is fundamentally identical with that of any other type of reciprocating engine, pump or compressor—in fact, any mechanism which involves a conversion of motion from reciprocating to rotating, or *vice versa*—but in view of the heavy loading and high speed to which it is subjected, its structural soundness is of more than ordinary importance, and it must be accurately made to ensure the utmost mechanical efficiency. A flimsy crankshaft, while it may possibly escape ultimate breakdown, is liable to deflection, either temporary or permanent, which may cause binding in the bearings, and serious mechanical friction, while inaccuracy in initial machining may result in much the same effects.

Crankshafts may be made with any number of throws or main journal bearings, but in the great majority of model petrol engines, single-throw cranks, having either one or two main bearings, are employed; these will, therefore, be given predominance in this article, though methods and procedure can generally be adapted to the more complex types. For the purposes of classification, four different methods of crankshaft construction may be considered, namely: (1) machining from solid; (2) machining from a forging or casting; (3) permanent fabrication by shrinking, brazing or welding; and (4) building up from detachable components. In most cases, methods 1 to 3 produce much the same result in respect of design, and application to engine structure design, but method 4 usually produces a special type of crankshaft, which is adapted to, and often necessitated by, a particular form of engine design.

Machining from Solid

This is perhaps the most popular, and commonly regarded as the most straightforward, method of making a crankshaft. It is certainly a sound method if properly carried out, as it ensures "whole metal" everywhere, and eliminates the possibility of faults or weakness which might occur in the joining of separate components; but it nearly always involves

cutting away a large quantity of metal, which may be a tedious business when only a light and low-powered lathe is available.

Crankshafts are often machined from round bar, in which case the maximum amount of metal must be machined away. A single-throw unbalanced crank may be made from a bar in which both the main journal (or journals) and the crankpin are offset from the bar centre, as in Fig. 1, but it is much more usual to turn the main journals on the axis of the bar, as shown in Fig. 2; this is a necessity in a multi-throw shaft, having the throws more or less symmetrically disposed around the main journal axis, but it is also an advantage in a single-throw shaft, if it is desired to provide integral balance weights opposed to the crankpin. The simplest and most common procedure in such cases is to make the balance weights as a part of the circular crank webs, the latter being cut away on either side of the crankpin to reduce unwanted weight in its vicinity. If, however, the method of construction shown in Fig. 1 is adopted, the balance weights must be made separately, and attached to the webs in any convenient manner; some difficulty is often experienced in fitting the webs, and there is also a potential risk of their becoming loosened or detached when the engine is running, which would be disastrous.

It may be said that in any model petrol engine, balancing of the crankshaft is at least desirable, if not absolutely essential, and for this reason, there is much to be said in favour of the method shown in Fig. 2, in spite of the extra machining work which it involves.

In most of the engines which I have designed, I have sought to reduce the amount of machining work required to the minimum, and thus, although the use of the above methods is quite permissible, I have generally recommended that the crankshafts should be made from rectangular bar. This not only reduces the amount of metal which must be cut away, but also enables the major part of it to be cut away by drilling and sawing. In the case of the crankshafts used on the "Kiwi" and "Kittiwake" engines, the bar used for making the shaft is sufficiently wide to enable the webs to be extended an equal radial distance on either side of the main journal centre. the "tails" opposite the crankpin providing a mounting for separate balance weights, which are each attached by two bolts passing sideways through the webs, and thus subject to shear stress as a result of centrifugal force. This form of attachment has proved highly successful in practice. (Fig. 3.)

It is possible to employ a very similar form of construction in a single-bearing or "overhung" crankshaft, and this has been done in several of my small engines, but the "Apex Minor" 15 cc. engine employs a rather unusual method of balance weight attachment, which eliminates the need for an extended "tail" on the crank-web. The balance weight in this case forms a sort of internal flywheel, and cannot become detached under the influence of centrifugal force unless it becomes broken or distorted, which is a very remote possibility. (Fig. 4.)

Setting Out

Perhaps the worst pitfalls in the construction of any type of solid crankshaft occur in the setting out, as it is possible to introduce errors in the dimensional accuracy of the crank throw, or the parallel alignment of the crankpin with the main journal. A slight error in the throw does not seriously affect the mechanical working of an engine, though it may influence the port timing of a two-stroke engine, and in multi-cylinder engines it is at least *desirable* that all the pistons should have exactly the same length of stroke. But errors of alignment are much more serious, and every care should be taken to avoid them.

The conventional method of setting out a solid crankshaft from a round bar is first to face both ends of the bar truly and then, after laying it in a pair of vee-blocks on a surface plate, to scribe a centre-line across both end faces, using a surface gauge with the scriber point set to the exact centre height of the bar. This may possibly involve some trial-and-error work in adjusting the scriber, which should be done on another bar of the same diameter, or in some other way to avoid causing confusion by the "trial" lines; the centre-lines on the bar should be made with a very sharp scriber, so as to be fine, but quite definite, and both ends of the bar should be marked without moving it in any way.

Next, the bar is turned in the vee-blocks through 90 degrees, so that the centre-lines are exactly at right-angles to the surface plate, as may be checked up by sighting them against a try-square; a cross centre-line is now scribed on both ends of the bar, which, in the case of a shaft made as in Fig. 2, represents the main journal centre. (If the procedure shown in Fig. 1 is adopted, the main and crankpin centres will be equally disposed above and below the centre of the bar). The height of the scriber point from the surface plate is now very carefully measured, and it is then raised or lowered exactly the correct distance for marking out the crank-throw; after this has been carried out, the intersections of the lines are carefully centre-punched, and finally centre-drilled to form the mounting centres for turning operations.

In marking out a multi-throw crank, the only difference consists in indexing the bar at various positions, spaced out at the required angular intervals, and marking radial centre lines to correspond with each crank throw. The lines representing throw dimensions should all be marked out at one setting of the surface gauge. In making a crankshaft from rectangular bar, the only difference in procedure is that the bar should be rested or clamped on parallel packing blocks, instead of in vee-blocks.

All this is very elementary, and may be regarded by experienced workers as universal knowledge; but I would assure them that there are many beginners who have not heard of the accepted workshop methods of laying-out and marking-off for common machining operations.

While this method of marking-out is sound in itself, and has been very much employed in full-sized practice, it does not always work out satisfactorily for a shaft of small dimensions.

*The Handyman 100 Years Ago

By G. A. GAULD

11—The Battle of the Crank

It may seem incredible today, but it is true nevertheless, that practical mechanics of a hundred years ago were busily engaged in heated arguments concerning the virtues and deficiencies of the crank. Its efficiency as a converter of power was in dispute. A reference to contemporary journals will show the controversial nature of the subject and a study of the long list of patents taken out during the nineteenth century for substitutes for the crank will demonstrate how actively inventors were engaged in the task of trying to find a practical solution to the problem.

It is difficult to gauge the strength of opinion in favour of the crank as an almost perfect means of converting the reciprocating motion of the piston of the steam engine into the rotary motion required by the machinery for which the engine had been designed to drive; people who are "on to a good thing" usually keep quiet about it. But there is no doubt about the fact that many practical men held a different view.

The opposing school of thought would appear to have been divided into two sections: those who sought to prove that the crank actually consumed or wasted power without having a better alternative to offer, and those more practical men who exercised their mechanical ingenuity in producing alternative mechanisms which they sought to demonstrate as being superior in every way to the common crank.

The "Theoretical" School

Before examining a few representative examples of these most intriguing substitutes, it is interesting to look at the problem through the eyes of one of the "theoretical" school. It must be realised that the problem is one of pure mechanics and for the moment, friction losses and other factors such as the mechanical simplicity of the crank are to be ignored. Here is a typical example taken from a letter dated July 25th, 1842:—

"Permit me to trace the crank through half a revolution, which represents a single stroke of the engine; and, of course, decides as to the whole useful application of its power, or otherwise. At the upper dead-power point, the available power is nothing. That, I think, will not be seriously controverted. Then, ranging through all the intermediate degrees, from nothing to full-power point (half-stroke), the power becomes a whole, and there, as the crank-pin descends, it transmits all it receives upon the machinery. Thus, the piston, as it ascends, at first can apply nothing, till, after struggling with, and gradually overcoming, opposing angles, it can apply, upon the machinery, the whole force which impels it. Now take the medium between the whole and the nothing, and you have a half. You have, therefore, an average available half for this half-stroke. Precisely the same thing though reversed in mode of application, takes place in the other half-stroke; and, therefore, on the whole single stroke (and this is continued while the engine is at work) you have an available half of that power, which is applicable on the machinery at the full-power point, and which, there, manifestly is the whole free force of the engine. Thus half the existing engine power appears to be available, and half neutralised and lost."

Lack of Effort

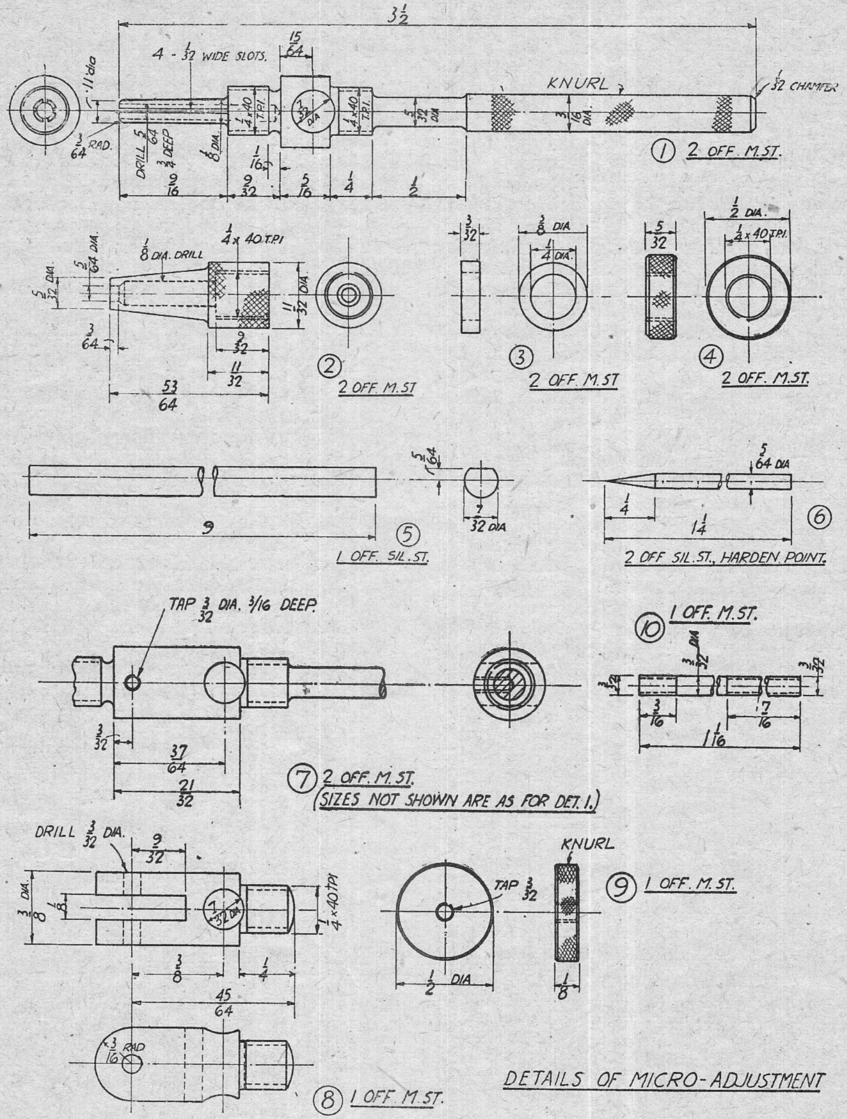
The apparent lack of effort at the dead centres is a feature of all the arguments against the crank. The inability to distinguish between power and pressure, and treatment of the problem as a question of statics, instead of dynamics, was responsible for the misconception. Power or energy *cannot* be destroyed. It was not an easy matter to disprove these theories without delving into mathematics and laborious explanations. Consequently, it is doubtful if the members of the anti-crank school were ever convinced of the inaccuracy of their views. The controversy raged on and new patents for crank substitutes were taken out into the beginning of the present century.

An appreciation of the simplicity and mechanical perfection of the crank probably did more to convince practical engineers of its value than all the theories involving pressures and crank angles. Most of the substitutes were mechanical monstrosities. It was obvious that their first cost would be high and maintenance heavy, and few provided for the smooth acceleration and retardation of the piston and other reciprocating parts. The case *for* the crank is beautifully expressed in a contemporary editori[al] as follows:—

"Let it be observed that, in the reciprocating piston the following things take place: the piston is to be put in motion in one direction, then stopped; then put in motion in the opposite direction, stopped again; motion in the first direction begun, and once more made to cease. But these processes which produce the change of state from rest to motion, and from motion to rest, require time. Matter in motion acquires momentum, which must be gradually removed, otherwise these moving parts are subjected to concussion, as by the stroke of a hammer, and either suffers or produces injury. On the other hand, when brought to rest, matter cannot be instantly set in motion in the opposite direction without a stroke and concussion equally violent. These effects, therefore, cannot be instantaneous;

(*Continued on page* 246)

* *Continued from page* 170, *"M.E." February* 14, 1946.



DETAILS OF MICRO-ADJUSTMENT

The Handyman 100 Years Ago

(Continued from page 244)

yet it is necessary that the motion which the steam gives off, should be converted into continuous and uniform motion, while the parts of the engine itself must be allowed time to be brought to rest without shock, concussion, or jolt, and gradually and gently be again urged to their greatest velocity in the opposite direction. All this the crank effects with the utmost nicety of adjustment ; it stops the piston as gently and softly as if a cushion of eiderdown were placed to receive it ; and after having brought it to rest, as gradually begins and accelerates its motion to its highest velocity in the opposite direction."

These words were written exactly one hundred years ago ; were we called upon today to present the case for the crank, I doubt if we could improve upon them.

(To be continued)

not be had; each piece had to be filed, scraped and drilled by hand-brace, close fitted and dowelled to make good point faces.

The forming and fitting of the bulwarks was the hardest job of all. The gun-ports, etc., were carefully marked out, drilled and filed, and, after the completion of the hull, balance and symmetry had to be right.

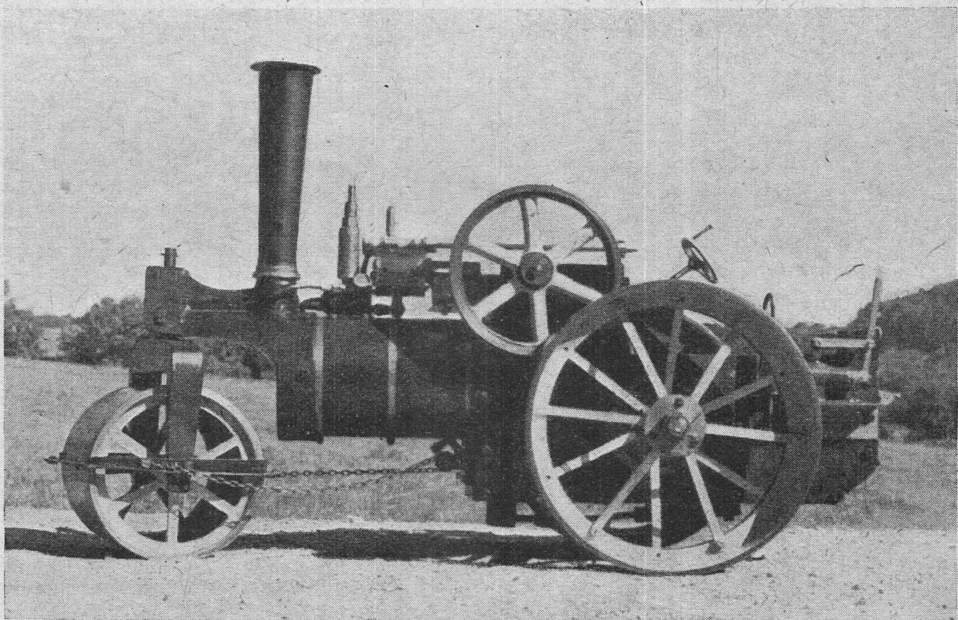
The masts, spars, yards, and sails were aluminium, the sails being of 24-gauge material. The guns and cradles were copper, the rigging-shrouds and ratlines are 24-gauge fuse-wire. The shrouds and ratlines were pegged out on a hardwood block large enough to take the lot; the ratlines had to be soldered to the shrouds, which was not an easy job, and required two attempts, the second with excellent results. The cross-trees and crows-nests were made from ebonite "black," the only non-metal details. After the masts, flags, yards and sails were fixed into position, the not-too-easy job of fixing the rigging-shrouds, etc., was at hand, and after a long period of much sweating with the aid of small pliers, the job was finished.

The model was fixed to a cradle and base, made from panels of an old wireless set.

The model has been exhibited in two handicraft exhibitions in aid of the Red Cross and Prisoner of War Funds, and has been awarded one premier award and two firsts.

After feeling very satisfied with my first effort, and having collected a fair amount of extra material, I began to look around for plans to build another model; so I sent for a Model-craft Plan Book and duly purchased the plans for constructing a model of the *Golden Hind*, Drake's famous ship.

After giving the plans a good deal of study, I decided to build a model larger than the first, and the experience I gained enabled me to alter my planning of construction. Thus, I was able to build a larger model with more details, as shown in photograph. The hull of this model was certainly more difficult to construct; it, together with the keel, gallery, bulwarks, decks, masts, yards, rails, hull fitments, sails, pennants, flags, etc., were made from aluminium scrap. The guns and carriages, cross-trees, and crows-nests, copper; the anchors, aluminium and copper; the ropes, shrouds and ratlines are 24-gauge fuse-wire; the dead-eyes are brass. The model was constructed entirely of metal and mounted on a teak base, and, in my opinion, it is the better model of the two. The lines of the hull are more pleasing to the eye than those of the *Elizabeth Jonas*.



A $1\frac{1}{2}$-in. scale free-lance steam roller on show recently at the High Wycombe model engineering exhibition. Built by Mr. W. J. Burgess and photographed in a realistic setting by Mr. A. Galeota

frames, making sure they are parallel, and put a big cramp over the lot, or grip in the bench-vice. Then run a No. 30 drill through the holes in frame, make countersinks in the contact face of the casting, follow up with No. 40, tap $\frac{1}{8}$ in. or 5 B.A., and insert screws. Hexagon-heads look pretty, but round-heads hold just as well.

If you prefer a plate centre, cut a piece of $\frac{1}{8}$-in. steel to a length of $3\frac{1}{8}$ in. and a width of $1\frac{3}{4}$ in. Make a slot in the middle $1\frac{1}{4}$ in. long and a full $\frac{3}{8}$ in. wide, for the bogie-pin; drill three $\frac{3}{8}$-in. holes in a line, and run them into a slot with a round file. If the plate is to be attached by angles, rivet a piece of $\frac{1}{2}$-in. by $\frac{1}{8}$-in. angle $\frac{1}{8}$ in. from the edge of each shorter side, as shown in the cross-section; then erect as described above for the casting, the angles butting up against the bogie-frames, whilst the ends of the plate enter the recesses in the tops of the bogie-frames, coming flush with each side. If you possess, or have the use of an oxy-acetylene blowpipe, don't bother about riveting on any bits of angle; just make the plate a very tight fit in the recesses in the tops of the bogie-frames. Set the lot true and square, then place in your brazing-pan or forge; a smear of Sifbronze flux along each joint, a gentle application of the blowpipe with "150" tip in it, plus a little No. 1 Sifbronze, and hey presto! your have a fabricated bogie equal to a one-piece casting. Warning—if this construction is used, leave fixing the brass horn-cheeks until the Sifbronzing process is over; because if the oxy-acetylene flame comes in contact with them, they just won't be there any more.

Axleboxes and Springs

The axleboxes are of the solid single-flanged pattern, made from bar, either cast or drawn; if the former, the metal will be supplied of the right section. but if the latter, use either $\frac{3}{4}$ in. by $\frac{9}{16}$ in., or the nearest larger obtainable. Bronze or gunmetal are preferable, but hard brass will do; the alloy sometimes sold as brass, known in the trade as "screw-rod," could also be used at a pinch, but should either be bronze-bushed or white-metalled. I sometimes used the latter wheeze when reconditioning the famous (or infamous?) junk merchants' productions—I've done a few in the last twenty years!—simply drilling the worn hole about $\frac{1}{8}$ in. larger than its proper size, tinning it, and filling it up with Hoyt's bearing-metal. When cold, the box was drilled to correct size, and the chippings saved for remelting; half my ancestry were Scottish, ye ken! Axles ran very sweetly in the white-metalled boxes.

A piece of bar about 3 in. long will make all four; a rebate $\frac{1}{16}$ in. deep and $\frac{1}{2}$ in. wide should be planed or milled in each narrower side, the process being exactly the same as for main axleboxes, so repetition is needless. This will leave a single flange $\frac{1}{16}$ in. in width and thickness. The four boxes can then be parted-off in the chuck, or sawn off and faced separately, Mark off two boxes for the axle-holes, drill first $\frac{1}{8}$ in., then 23/64 in., and use them as jigs to drill the others, as described for the main boxes, marking both the boxes and the openings in the bogie frames, so they don't stand any chance of getting mixed up. You can ream right away, as the boxes are free to tilt if required on a rough road, owing to the single flange. The oil holes are drilled diagonally, so that the driver can do the needful by poking the spout of his bosom companion between the spokes of the wheel. A driver's two best pals are his oil feeder and tea-bottle; the former lubricates the engine, and the latter himself. Experience teaches!

The springing arrangement is similar to that on the full-sized engine, each axlebox taking the weight *via* two spring pins connected to an overhead beam which bears on the top of the box; see detail illustration. We may be lucky enough to get castings for the beams; if not, they can easily be filed from $\frac{1}{2}$-in. by $\frac{1}{4}$-in. bar, either brass or steel. Shape and dimensions are given in the drawings. The ends are drilled and tapped for the pins, at $1\frac{3}{8}$ in. centres; and as the pins must be square with the beam, drill the holes either with a bench-drill, or pillar-drill, holding the beam horizontally in the machine-vice; or use the lathe, with the drill in three-jaw and the machine-vice held against a drilling-pad on the tailstock barrel. The pins are $1\frac{5}{16}$ in. long overall, of $\frac{1}{8}$-in. steel rod, screwed both ends as shown. To assemble, merely poke each pair of pins through their respective lugs on the frame, and put a spring of 22-gauge tinned steel wire on each pin, securing with an ordinary commercial nut and washer.

Wheels and Axles

The bogie wheels are $2\frac{3}{8}$ in. diameter on tread, with flanges $\frac{1}{8}$ in. deep and $\frac{1}{16}$ in. in thickness, well radiused at the root of the flange; the treads are $\frac{3}{8}$ in. wide, and are parallel, except for a slight chamfer. The bosses stand out $\frac{1}{16}$ in. from the rim. They should have ten spokes. They are turned exactly as described for the coupled wheels. The axles are also machined as described for the straight axles of the coupled wheels, and are $\frac{3}{8}$ in. diameter, with $\frac{5}{16}$-in. wheel seats, turned to a press fit in the wheel-bosses, as previously described. Press one wheel on each axle; put the axleboxes in place in the bogie frame; then push the axles through each pair of boxes, putting the other wheel on as far as it will go by hand, then squeezing right home in the vice, or by any other means you may fancy. The wheels should spin perfectly freely by hand. Warning to beginners: mind you don't put the axleboxes in upside down, which wouldn't matter much until the driver went to oil up, and found the oil hole at the bottom, probably provoking a little railroad Esperanto.

I guess some of the friends and relations of Inspector Meticulous will crib about the absence of hornstays, arguing that you can't get the axleboxes out without taking the wheels off; but you don't have to get the boxes out any more until they wear, and want bushing or re-metalling, and then you have to get the wheels off anyway, so what on earth is there to start worrying about? Some folk who raise objections, are like an old friend of mine whose wife once remarked, with a smile, "Do you know, Ted's never really happy unless he's miserable!"

The bogie, when in place on the engine,

amount below the casting, at the same time admitting a $\frac{1}{8}$-in. rubbing-washer between bolster and centre casting. A built-up bogie should be fitted as shown in the detail drawing. The bogie pin should be 9/32 in. long between shoulders. The lower screwed part should be $\frac{7}{16}$ in. long, screwed $\frac{1}{4}$ in. by 40 and furnished with a nut and washer to match; the upper end should be turned to $\frac{5}{16}$ in. diameter, put through a $\frac{5}{16}$-in. hole in the bolster-plate, and riveted over. The assembly is shown in the illustration. The next stage in construction will be the radial axle.

Survival of the Fittest

The recent remarks in this journal about things getting into a groove, recalls several observations on locomotive design which were put forward in the letters which came to hand in response to my comments on the S.R. Pacifics. One correspondent, in particular, referred to the G.W.R. 1000 class in very scathing terms, as being merely a variation of a design that appeared in the early 1900's, and cracked up certain "ultra-modern" designs, chiefly by virtue of the fact that they were "something different." Two or three others took much the same view of things, saying that locomotive design had got into such a groove that many engines running today were identical in principle with the *Rocket* of 1829. Maybe so, but to your humble servant it seems that the principles of the *Rocket* have been tried, tested, and not found wanting; in other words, the survival of the fittest. No student of locomotive history can deny that the various attempts to break away from what we might call the "common or garden type" of locomotive, have practically all faded into obscurity. To quote a few examples there were the engines with a driving axle running in fixed bearings, with no wheels on it, the other axles being coupled to it by the usual rods; engines having a small high-speed "steam-motor" something like an automobile engine, driving the main axles through gears; the turbine driven engines, both condensing and non-condensing, with gear or electric transmission, the Kitson-Still engine, a combination of steam and I.C.; and others. Then there were various forms of "fancy" valve-gear, with poppet valves; not all dead yet, but dying—in this country, at any rate. A start has even been made on eliminating some of the three-cylinder types, converting them to plain and simple two-cylinder jobs, thereby increasing efficiency and reducing maintenance. When a simple design has proved its worth, all working enginemen will agree that there is no sense in introducing complications, just for the sake of "modernity," when the same or better results can be obtained by keeping to the older pattern of engine. If a "startling" design produced "startling" improvements in both efficient performance and reduced maintenance, *then* it would be a different tale!

Ancient History

Some recent "improvements" are really ancient history. "Locomotion" of 1825 had steam-jacketed cylinders; they were sunk in the boiler. Old Tim Hackworth fitted his "Royal George" of 1827 with a separate shaft for the valve-gear (over a century before it was done at Eastleigh!) but had trouble with it and eventually discarded it. Bouch, of the Stockton and Darlington Railway, used a multiple-jet blast-pipe back in the 'sixties, whilst the double blast-pipe was used in U.S.A. in the 'seventies. Stroudley's clasp brake was the rock-bottom of simplicity, far more efficient than the modern pattern with its collection of rods and pins; and I could cite many other instances, if space (and readers' patience!) permitted. To sum up, unofficial history tells us that old man Noah used a hammer for knocking in the nails when building the Ark; one of my neighbours, who is an expert carpenter and joiner, still uses a hammer for knocking nails in, finding it more handy and efficient than an electrically-operated pile-driver. When the masons of Biblical times built King Solomon's temple, they used a maul and chisel for dressing the stones, and the brass castings were made in sand moulds; the other day I saw a Council workman dressing a granite kerbstone with a maul and chisel, and they still make brass castings in sand moulds at the Swindon locomotive factory. *Verb. sap.*!

Locomotive News

IN September, 1939, the Great Western Railway suspended the practice of naming its passenger tender engines, the last engine to receive a name being No. 6915, *Mursley Hall.* Since that time, further engines of the "Hall" class have been constructed and numbered 6916 to 6970, inclusive. These include the batch of "Modified Halls," completed in 1944, numbered 6959 to 6970; but the entire lot from 6916 onwards were nameless.

Just lately, however, engine No. 6967 has returned to work, after overhaul at Swindon, and is carrying the name *Willesley Hall*; so there seems to be some justification for assuming that the naming of locomotives is being resumed by the G.W.R.

Another item of interest to locomotive enthusiasts is that a complete scheme of renumbering is being introduced on the L.N.E.R. Already, our old friend No. 4472, *Flying Scotsman*, has been renumbered 502, and others will be similarly treated as opportunity occurs. The full scheme is very comprehensive.

The Southern Railway, too, seems about to liven things up a little. "Schools" class engine No. 934, *St. Lawrence*, has emerged from a visit to works fully painted in the pre-war malachite green with black bordering and white lining. Presumably, for the present, only the express passenger engines will be repainted in this way; but it is certainly good to see! Let us hope that they can be kept *clean.*

12-slot Maltese cross *does not* give the same performance as a 4-slot Maltese-cross geared down 3-1 would do.

Under normal conditions, or almost any conceivable "wangled" ones, the driving-pin will have to move through an arc almost double for a 12-slot Maltese-cross, as compared with its 4-slot equivalent.

It seems, therefore, that, unless "Excogitate" has neglected to mention some very important point, that his film movement is taking about twice as long as it needs to do.

And, if this is so, then it appears that his subsequent experiments to get rid of flicker have been conducted without regard to the most important factor of all, namely, the time taken to move the film, as this influences the size of the shutter blades. Assuming that it is possible to move the film in 1/150 second or faster, for each frame, then we may hope to reach a point where persistence of vision will cause no flicker to be detectable.

In a projector I am now designing, I am attempting to cut the timing of the actual film movement down to 1/200 second per frame. This will not be accomplished by a Maltese-cross gear of any kind, however, but by an intermittent motion which seems to me to be definitely superior. In this gear the driving member drives a 12-tooth film sprocket direct (or, at any rate, without gears). As indicated, the film movement takes place in less than an eighth of a revolution of the driving member. Should anyone be interested in this gear I should be pleased to describe it.

Before closing, I should like to mention a snag which I came across in my experiments; I wonder if anyone else has had a similar experience. When making my sprockets I took very great care in measurements and found that apparently the pitch of the film perforations was 7.5 mm.

I therefore made 12-tooth sprockets to this pitch; it seems to be correct, but occasionally one finds a film in which the pitch is inaccurate; one film I have shows an error of 1/3 of a mm. in 12 frames. This does not seem very serious, as it would amount to only about a thous. per frame, but it is sufficient to cause damage to the film when run on an accurate sprocket, so it appears that one cannot always blame the projector itself for film damage. This particular point seems to call for a specially designed sprocket having a modified pitch diameter.

Yours faithfully,

Oldham. R. Moss.

Clubs

"Aylesbury Gang" and Luton and District Model Engineers

The "Aylesbury Gang" now have two sections, one in Aylesbury and one in Luton.

The Aylesbury section held their first meeting on January 31st, twenty-one members being present.

Future meetings will be held on the third Wednesday of each month, at the Congregational School, High Street, Aylesbury, at 7.30 p.m.

The Luton section hold meetings on the first Friday of each month, at The Griffin, Chapel Street, Luton.

Hon. Sec., Luton Section: H. D. Bond, 19, Park Square, Luton.

The Brighton and District Society of Model and Experimental Engineers

At our usual meeting on Friday, February 8th, a demonstration of silver soldering was given by Mr. Mead. A suggestion was made to get some members' badges, and any help from other club secretaries would be appreciated.

March 8th, demonstration of oxy-acetylene welding and Sifbronzing; March 22nd, "Bits and Pieces," night; April 5th, lecture on "Angles."

Hon. Sec.: E. L. Mead, 73, Langdale Gardens, Hove 3.

Scunthorpe Society of Model Engineers

This society will be holding its first exhibition from April 1st to 6th, 1946, in the Doncaster Road Boys' School, Scunthorpe. The exhibits will be divided under three main heads: boats, mechanical models, and metal-work; there will be five classes under each head, some of them "open." Entry-forms and particulars may be obtained on application to the Hon. Sec.: S. W. Norman, 14, Gervase Street, Scunthorpe.

The Medway Model and Experimental Engineering Society

The general meeting, held on January 22nd, was very successful; thirty-five members attended. After the election of officers and workshop committee, Mr. F. E. Howlett described his visit to the recent exhibition at Ipswich.

Meetings are held every Tuesday evening at the Club's headquarters, Skinners' Yard, Railway Street, Chatham.

Hon. Sec.: F. E. Howlett, 59, Bryant Road, Rochester, Kent.

Coventry Society of Model and Experimental Engineers

An interesting evening was spent examining and discussing members' exhibits at the "model night" held on February 1st. Amongst the more usual items, a fly-fishing casting-reel attracted well-deserved attention.

Hon. Secretary: J. F. Back, 3, Macaulay Road, Stoke, Coventry.

Leicester Society of Model Engineers

The first post-war meeting, held on January 25th, was very well attended and gives high hopes of a real live society for Leicester. We hope to get going a programme to suit all tastes, also to restart our annual exhibitions.

The society very much thank the directors of The Precision Engineering Works for the use of their canteen for our meetings.

Hon. Sec.: J. Walker, 78, Waltham Avenue, Leicester.

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For Sale, Challenger Precision Lathe (similar Southbend), 5½" centre, 3 chucks, four-way tool-posts, set collets, motorised, 400/3/50, practically new, £100.—L. W. HUNT DRUM CO., 10/11, Archer Street, Piccadilly, London, W.1. (GERrard 8911/2/3).

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Sloane and Chase Toolmakers Plain Lathe, countershaft, full set collets, 3-jaw chuck, 1 h.p. single phase motor and starter, lineshaft with bearings and pulleys, sensitive drill with countershaft, grinding spindle with countershaft, many extras. Best offer over £40.—Box No. 3912, MODEL ENGINEER Offices.

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Lathe Wanted, Atlas 5", Sheldron 5", or Drummond 3½"; also power Bench Drill, up to ½". Must be perfect condition.—C. F. HOWES, 89, Rockingham Road, Kettering, Northants.

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